*The Institute of Physics*

**BULLETIN**

APRIL 1958 · VOL. 9 · No. 4

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*The Bulletin is published by The Institute of Physics for circulation to its members.*

# *Notices to Members*

**Thirty-eighth Annual General Meeting**

Notice is hereby given that the Thirty-eighth Annual General Meeting of The Institute of Physics will be held at 5 p.m. on Tuesday, July 1, 1958, at the Institute's House. Attendance is limited to Fellows and Associates of the Institute. The business to be conducted is the consideration of the Board's report, the accounts and balance sheets for 1957, the declaration of the election of the Honorary Officers and other members of the Board nominated, and the election of auditors. A copy of the annual report and accounts is printed in this issue of the *Bulletin*. Further copies will be sent on request.

F. A. VICK,
*Honorary Secretary.*

April 10, 1958.

**Nominations to the Board**

In accordance with Article 47 of the Articles of Association of the Institute, notice is hereby given that the Board has nominated the undermentioned persons to fill the vacancies stated which will occur on September 30, 1958.

The Ordinary Members nominated were selected by ballot from a list of suggestions made by Branch and Group Committees and members of the Board.

Attention is directed to the terms of Article 48 which reads as follows : " After the notice (*i.e. this notice*) mentioned in the last preceding Article any five Members (i.e. Fellows and Associates) may nominate within two weeks of receipt by them respectively of such notice, but not later, any other duly qualified person as a candidate for election to any one or more of the said Offices by depositing such nomination in writing at the Registered Office of the Institute together with the written consent of the nominee to accept office if elected. No member may nominate more than one candidate in any year." Ballot papers will be circulated in due course to Fellows and Associates and the result of the ballot will be announced at the Annual General Meeting on July 1 next.

**President :**

SIR GEORGE THOMSON, M.A., LL.D., Sc.D., Hon.F.Inst.P., F.R.S., *Nobel Laureate*, Master of Corpus Christi College, Cambridge.

**Vice-President** (*one vacancy*) :

R. W. SILLARS, B.A., D.Phil., M.I.E.E., F.Inst.P., Group Leader, Research Department, Metropolitan-Vickers Electrical Co. Ltd., Trafford Park, Manchester.

**Hon. Treasurer :**

*J. TAYLOR, M.B.E., Ph.D., D.Sc., F.R.I.C., M.I.Min.E., F.Inst.P., Director, Imperial Chemical Industries Ltd.

**Hon. Secretary :**

*PROFESSOR F. A. VICK, O.B.E., B.Sc., Ph.D., A.M.I.E.E., F.Inst.P., Professor of Physics, University College of North Staffordshire.

**Ordinary Member** (*two vacancies*) :

A. C. MENZIES, M.A., D.Sc., F.Inst.P., F.R.S.E., Controller of Research and Development, Hilger & Watts Ltd., London.

J. TOPPING, M.Sc., Ph.D., D.I.C., F.Inst.P., Principal, Brunel College of Technology, Acton.

F. A. VICK,

April 10, 1958. *Honorary Secretary.*

* *For re-election to the same office.*

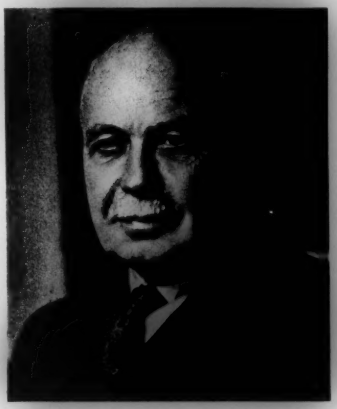
**Election to Honorary Fellowship**

Notice is hereby given that in accordance with By-law 9, the Board has nominated Sir William Lawrence Bragg, O.B.E., M.A., D.Sc., F.Inst.P., F.R.S., *Nobel Laureate*, for election as an Honorary Fellow of the Institute and that the result of the ballot will be declared at the 38th Annual General Meeting. Ballot ppers will be circulated later to Fellows and Associates.

F. A. VICK,

April 10, 1958 *Honorary Secretary.*

Sir Lawrence Bragg is the son of a former President and Honorary Fellow of the Institute, Sir William Bragg, O.M., and he became widely-known in 1915 when, at the age of 25, he shared with his father the Nobel prize awarded for their outstanding work on the application of X-rays to the study of crystal structure. Four years later Sir Lawrence succeeded Rutherford as Langworthy Professor of Physics in the University of Manchester, where he remained for eighteen years until appointed Director of the National Physical Laboratory. He left the Laboratory after one year, however, to succeed Rutherford as Cavendish Professor of Experimental Physics in the University of Cambridge.



*Elliott & Fry*

In 1954 Sir Lawrence became Resident Professor of Natural Philosopiy in the Royal Institution, a post which his father had occupied with great distinction. In the last four years Sir Lawrence has earned the gratitude of scientists for the excellent work that has been done in putting the unique resources of the Royal Institution to the task of giving school children a new insight into science through a brilliant series of lectures and experimental demonstrations.

Sir Lawrence has been a Fellow of the Royal Society for thirty-seven years and has received a Royal Medal and the Hughes Medal ; he has received honorary degrees of ten universities.

A founder Fellow of the Institute and a former Chairman of the Manchester and District Branch, Sir Lawrence was Vice-President of the Institute from 1934-38 and President from 1939 until 1943.

**The Institute's Finances**

For those members who wish to have a simple general picture of the Institute's financial affairs as a whole, a set of consolidated accounts is published in the *Bulletin* each year. These combine the accounts which will be found in the

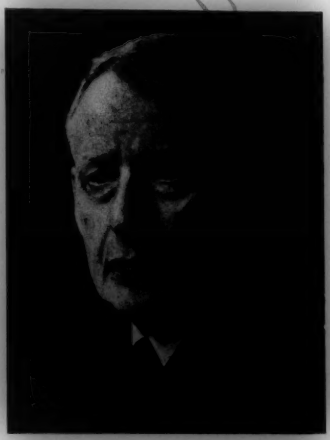
more formal statements included in the Board's annual report (p. 92 of this issue) to be presented for adoption to the Annual General Meeting to be held on July 1 next.

The year 1957 ended with a deficit of £2,964. Whereas the budget approved by the Board in December, 1956, anticipated a final surplus of £1,215, it became clear during the year that the increasing activities and rising costs for which supplementary votes were made would, with the lower receipts from the normal sales of publications (£2,231 less than budgeted), turn the anticipated surplus into a deficit. The sale of the stock of books to Messrs. Chapman & Hall Ltd. (reported in the December *Bulletin*) realized £2,833 and is shown as a separate item. Income from members' fees shows a welcome increase of £979 compared with last year and was £513 more than the budgeted figure. Turning to the expenditure side, salaries and wages cost £1,706 more than the budgeted figure, partly on account of two additions to the senior staff during the year (a Finance Assistant and an Education Assistant) and partly because of the increasing wages now required to retain and recruit clerical staff. The increase in fares and other costs is reflected in the item "Travelling expenses, Board and Committee meetings," which is £561 more than the budgeted figure. The disappointing attendance at the Oxford Convention (252 compared with 412 at Bournemouth and 420 at Buxton) cost the Institute £536 in payments to colleges in which accommodation had been reserved and payment guaranteed—an interesting comment on the view often expressed by members that attendance would be improved by using university accommodation in preference to hotels at holiday resorts.

The Board wishes to remind members that in presenting these accounts last year it was stated (p. 111, April, 1957, *Bulletin*) that "it has been possible to postpone further increases in members' subscription rates which at that time (1955) was considered likely to be necessary by January, 1957." But it will be clear from the consolidated balance sheet (p. 78) that the Institute's reserves are too small to allow for continuing deficits and the Board has under serious consideration what further economies may be necessary and what additional sources of income can be found. It seems inevitable that plans for raising members' subscriptions must be shortly given serious consideration and, in the meantime, the budget approved by the Board in December last (summarized in the January *Bulletin*) is being critically re-examined in the light of additional information now available.

# *Nominations to the Board*

**President : Sir George Thomson**

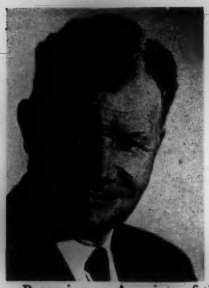


Sir George Thomson is the distinguished son of a distinguished father (Sir Joseph Thomson—"J.J."), who was the Institute's first Honorary Fellow and subsequently President. Sir George saw five years of war service immediately after graduating in 1914. He became Professor of Natural Philosophy in the University of Aberdeen in 1922 and in 1930 was appointed Professor and Head of the Department of Physics in the Imperial College of Science and Technology, London. After twenty-two years at Imperial College he was elected Master of Corpus Christi College, Cambridge, in 1952. Sir George was awarded the Nobel prize for physics in 1937, an award his father had received in 1906. He has also received the Hughes and Royal Medals of the Royal Society.

Sir George was Chairman of the first British Commission on Atomic Energy and has been Scientific Advisor to the Air Ministry and to the British Delegation to the United Nations Atomic Energy Commission.

He was elected an Honorary Fellow of the Institute in 1956.

**Vice-President : Dr. R. W. Sillars**



Graduating from Cambridge in 1932, Dr. Sillars has spent the whole of his professional career with Metropolitan-Vickers Electrical Co. Ltd., Manchester. For the last five years Dr. Sillars has been Physics Group Leader of the Research Department of the Company.

Becoming an Associate of the Institute in 1938 and a Fellow in 1951, Dr. Sillars has been Chairman of the Manchester and District Branch.

**Honorary Treasurer : Dr. James Taylor**

Dr. Taylor graduated in physics in the University of Durham in 1923 and carried out research in Paris, Utrecht and Cambridge. In 1928 he joined the staff of Imperial Chemical Industries Ltd. at Ardeer, Scotland, becoming Director of Research to the Nobel Division in 1946 and Joint Managing Director 1951. The following year he was appointed to the Main Board in London.

**Honorary Secretary : Professor F. A. Vick**

Professor Vick graduated from the University of Birmingham and before the war was a Lecturer at University College, London. By the end of the war he had become Assistant Director of Research of the Ministry of Supply. After five years on the physics staff of the University of Manchester, Professor Vick became the first Professor of Physics in the new University College of North Staffordshire in 1950.

Elected to Associateship of the Institute in 1936 and Fellowship in 1941, Professor Vick has been Honorary Secretary and later Chairman of the Manchester and District Branch and a Vice-President of the Institute.

**Ordinary Members**

**Dr. A. C. Menzies**

A graduate of the University of Cambridge, Dr. Menzies was Head of the Physics Department in the then University College, Leicester, and Professor of Physics in the University of Southampton. After technical service in the Royal Air Force during the war, Dr. Menzies left academic life to become Controller of Research for Hilger & Watts Ltd.

**Dr. J. Topping**

A graduate of the universities of Manchester and London, Dr. Topping was for 14 years Head of the Department of Mathematics and Physics at the Polytechnic, Regent Street. Later he became Principal of Guildford Technical College and of Acton Technical College. The advanced side of the latter institution has now become the Brunel College of Technology, Acton, of which Dr. Topping is the Principal.

A former Honorary Secretary and Chairman of the Education Group, assessor for National Certificate examinations and examiner for the Graduateship examination, Dr. Topping has also been Chairman of the Institute's Membership Committee

# THE INSTITUTE OF PHYSICS

## CONSOLIDATED INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST DECEMBER, 1957

| 1956 | | | 1956 | | |
|---|---|---|---|---|---|
| £ | | £ | £ | | £ |
| 19,051 | To Production and distribution of publications (excluding cost of labour and overheads) ... | 20,303 | 32,589 | By Receipts from publications ... ... ... | 34,769 |
| 15,860 | „ Salaries and National Insurance and staff superannuation ... ... ... ... ... | 19,206 | 9,120 | „ Receipts from advertisements in Journals ... | 8,543 |
| 5,323 | „ Rent, rates, lighting, cleaning and maintenance | 6,278 | — | „ Receipts from sale of book stock ... ... ... | 2,833 |
| 778 | „ Travelling expenses, Board and Committee meetings ... ... ... ... ... | 1,311 | 14,033 | „ Members' subscriptions, entrance and application fees ... ... ... ... ... ... | 15,013 |
| 2,352 | „ Printing and stationery ... ... ... ... | 2,395 | 640 | „ Dividends and interest ... ... ... ... | 640 |
| 1,527 | „ Bulletin (net) ... ... ... ... ... | 1,806 | 157 | „ Donations received by Trust Fund ... ... | 157 |
| 2,178 | „ Postage and telephone ... ... ... ... | 2,452 | 776 | „ Non-Members' Conference fees ... ... ... | 231 |
| 2,499 | „ Branches and Groups (including Australia) ... | 2,702 | — | „ Deficit for the year before depreciation, etc. ... | 386 |
| 81 | „ Conferences and Conventions (net) ... ... | 1,156 | | | |
| 234 | „ Educational work, examinations (net) and special reports ... ... ... ... ... ... | 540 | | | |
| 1,384 | „ Miscellaneous expenses and House vote... ... | 1,680 | | | |
| 300 | „ *Science Abstracts* basic payments ... ... ... | 300 | | | |
| 500 | „ Repayment of contribution to X-ray Fund for book ... ... ... ... ... ... | — | | | |
| 52,067 | | 60,129 | | | |
| 1,350 | „ Decrease in stock of publications ... ... | 2,443 | | | |
| 3,898 | „ Surplus for the year before deduction for depreciation, etc. ... ... ... ... ... | — | | | |
| £57,315 | | £62,572 | £57,315 | | £62,572 |
| — | To Balance brought down ... ... ... ... | 386 | 3,898 | By Balance brought down ... ... ... ... | — |
| 378 | „ Amount written off expenditure on alterations, etc., to House ... ... ... ... ... | 378 | — | „ Final deficit for the year ... ... ... ... | 2,964 |
| 1,205 | „ Depreciation of furniture and fittings ... ... | 1,215 | | | |
| 985 | „ Leasehold Redemption Policy ... ... ... | 985 | | | |
| 1,330 | „ Final surplus for the year ... ... ... | — | | | |
| £3,898 | | £2,964 | £3,898 | | £2,964 |

# THE INSTITUTE OF PHYSICS

## CONSOLIDATED BALANCE SHEET, 31st DECEMBER, 1957

| 1956 | | | |
|---|---|---|---|
| £ | | | £ |
| 4,832 | LIFE MEMBERSHIP FUND ... ... ... ... | | 4,774 |
| 23,497 | RESERVE FUND... ... ... ... ... ... | | 22,241 |
| 345 | ENDOWMENT TRUST FUND ... ... ... ... | | — |
| | CURRENT LIABILITIES :— | | |
| 9,689 | Subscriptions to 1958 Journals and payments from members in advance ... ... ... ... | 10,529 | |
| 5,635 | For expenses including production of publications | 5,843 | |
| 16,960 | X-ray Index Fund ... ... ... ... ... | 19,743 | |
| £60,658 | | | £63,130 |

| 1956 | | | | |
|---|---|---|---|---|
| £ | | | £ | £ |
| | FIXED ASSETS :— | | | |
| | FURNITURE, FITTINGS AND OFFICE EQUIPMENT, at cost ... ... ... ... ... | | 6,838 | |
| 1,310 | *Less :* Depreciation ... ... ... | | 5,928 | 910 |
| | ALTERATIONS, IMPROVEMENTS AND ADAPTATION OF PREMISES, at cost ... ... | | 10,289 | |
| 6,137 | *Less :* Depreciation ... ... ... | | 4,530 | 5,759 |
| | CURRENT ASSETS :— | | | |
| 4,900 | STOCK ON HAND, at valuation ... ... ... | | | 2,494 |
| 6,869 | DEBTORS ... ... ... ... ... ... | | | 6,749 |
| 12,279 | INVESTMENTS, at cost ... ... ... ... (*Estimated market value, 31st December, 1957, £28,873*) | | | 31,089 |
| 6,895 | LEASEHOLD REDEMPTION POLICY ... ... ... | | | 7,880 |
| 22,268 | BANK BALANCES AND CASH IN HAND ... ... | | | 7,448 |
| — | ENDOWMENT TRUST FUND ... ... ... | | | 801 |
| £60,658 | | | | £63,130 |

*Vol. 9, April, 1958*

# The General Circulation of the Atmosphere*

By Professor P. A. SHEPPARD, B.Sc., F.Inst.P.

(*Professor of Meteorology, Imperial College of Science and Technology, London*)

## 1. THE CONCEPT

METEOROLOGY is one of the observational sciences, meaning that its data are "given." But imagination is necessary to know what data are likely to be interesting, ingenuity is required to extract them from the system we study, and substantial material resources may be needed to obtain a representative set. Thus, whereas superficially the system may be said to pose its own problems, their formulation in an effective, stimulating and useful manner calls for high scientific initiative and some persistence.

Now it requires only a very short inquiry of the atmosphere to discover that what goes on at one place and time is intimately related with what goes on elsewhere at the same and earlier time. A thunderstorm occurs over Bristol on a Wednesday afternoon, say, in summer because the atmosphere we suppose has been heated from below by the summer sun, but the thunderstorm has occurred in air made ripe for its realization by the history of that air over many previous days. The same sun on the same ground the next day may well fail to produce the tiniest puff of cloud because the air then passing over Bristol has had a different history and so has a different thermal structure and a different distribution of water vapour. If one's concern with the thunderstorm one day and its absence the next were merely to account for the weather sequence in terms of the different air masses present on the consecutive days then one would not, in general, have to look more than a few hundred miles away from Bristol nor more than a day or so backwards in time. (By such means in reverse are short-term weather forecasts prepared.) But if the sequence of weather at Bristol, and elsewhere, is to be understood in a more comprehensive fashion, if, that is, the whole train of physical events in the atmosphere is to be integrated, a global approach is required. For the rain which fell on Bristol on the Wednesday afternoon may have largely entered the atmosphere as vapour from the tropical seas a week or two earlier. To the psalmist and many others the wind bloweth where it listeth, but the meteorologist cannot be content to leave the matter there.

It is with the global approach to the atmosphere that I shall be concerned in this paper. The atmosphere is in a state of continuous evolution and because that evolution is largely brought about by the motion of the air we speak of the global study as the study of the general circulation of the atmosphere. It effectively comprises the whole of meteorology—and some oceanography too, but the accent is on the whole as the sum of its many parts.

The concept of the general circulation is about as old as the Royal Society, for it was Halley who first pointed out that there was a broad pattern in the *surface* winds of the world, with motion generally from an easterly point in lower latitudes and from a westerly point in higher latitudes. On this grand scheme were many perturbations, more or less large in scale and intensity, a kind of background noise sufficient on occasion to drown the music of the spheres. I shall try to show below that what was earlier thought of as noise is a very pertinent part of the grand theme itself, the "development" without which the "sonata" itself does not exist.

But meteorologists from the time of Halley to the Second World War were only vaguely aware of the problem they were posing themselves for they had rather little knowledge of what went on in the main body of the atmosphere away from the earth's surface. Then came the radio sonde, and radio and radar wind apparatus, so that a three-dimensional picture to some 20 km in height has now been built up, not merely of the general pattern of wind and temperature but, for a large part of the northern hemisphere at least, of the pattern as it exists day by day and thus of its evolution. And so we reach the International Geophysical Year with the meteorological effort avowedly concentrated on the general circulation and the cry for yet more data—from the tropics, from the oceans, from the polar regions and to yet greater heights. It is perhaps as well that I should be giving my thoughts on the general circulation before the welter of new data on the subject come to confound them.

* The substance of a lecture delivered to the South-Western Branch of the Institute on January 17, 1958.

## 2. SOME OF THE FACTS

*Decomposing the flow*

We begin by assuming that it may be profitable to regard the motion of the atmosphere as composed of a suitably formed mean motion upon which is superposed a spectrum of turbulent motions. The manner of forming the mean will determine what comprises the turbulence and for present purposes we shall consider mean values taken at fixed levels round latitude circles and over periods of time of order a season, or over several similar seasons. We thereby arrive at a pattern of mean motion which is a function of latitude, height and season and the turbulence comprises all motions of scale less than the latitude circle in horizontal extent and less than the season in temporal duration. If we are then able to show that the fields of mean and turbulent motion so evaluated are dynamically self-consistent and, in combination, self-maintaining, we shall have a partial explanation at least of the general circulation. It will only be partial because our method of taking means will have eliminated variations in longitude and so we shall have no immediate clue why the wind and weather at Bristol may on average differ from that at Irkutsk or Winnipeg on the same parallel. This difference is of legitimate interest, particularly to the inhabitants of the respective areas, but we can only solve our problems in stages and I have anyway space only to deal with part of the problem.

*The mean motion*

The mean motion of the air has three components which we take to be zonal (along the parallel), meridional (along the meridian) and vertical. Of these the dominant component is the zonal motion $U$ (positive for westerlies, negative for easterlies) and this is shown in Fig. 1 by a mean meridional cross-section of the atmosphere up to a height of about 20 km. This layer comprises about 95 per cent of the atmosphere by mass. Higher levels are not yet well explored and though we know something about the distribution of winds up to 100 km or so I shall not discuss that region here. Fig. 1 shows the existence of surface easterlies in lower latitudes—the well known Trades—and of surface westerlies in higher latitudes, except quite near the poles. There is a rapid increase of westerly wind with height (or, in the Trades, a decrease of easterly wind before reaching increasing westerlies) up to very near the tropopause, at some 10 to 16 km, the lower level of tropopause being at the higher latitude. Above the tropopause the westerlies decrease with height.

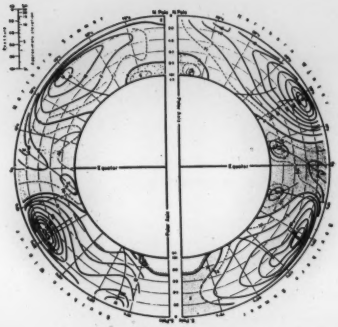


Fig. 1. *The mean zonal wind speed averaged over all longitudes as a function of latitude, height and season. Height, greatly enlarged relative to earth radius, is shown on a linear pressure (=mass) scale. The mean zonal wind (westerly positive, easterly negative) has the same value along any one line, the value being shown in m/s on the line. Regions of easterlies are shown shaded. Note the sub-tropical jet in the high troposphere at about latitude 30° (or more in Northern Summer).* (*After Mintz.*)

The tropospheric increase of westerly wind with height is greatest in the horse latitudes (ca. 30-35°) where, at the surface, we have the transition from surface easterlies to westerlies, and so aloft we find the sub-tropical jet in which the mean wind reaches an absolute maximum of about 40 m/sec* in winter.

The pattern of mean meridional motion $V$ (positive for poleward motion in the N hemisphere) is more difficult to determine, because it is relatively weak and is associated with turbulent motions an order of magnitude greater, except in the lower-atmosphere Trades. It is certain that there is equatorward motion in the Trades, of about 1 m/sec, and poleward motion above them. (Continuity demands that there should be no long-term flow of air across any parallel, so that poleward and equatorward motion must always be superposed over any parallel.) In middle latitudes the meridional motion is probably in the reverse sense, poleward below and equatorward above, again of order 1 m/s, but weaker than the low-latitude circulation.

The mean vertical motion $W$ (positive upwards) is far too weak to be observed directly but again continuity may be invoked, once the mean

* 1 m/sec is very approximately 2 mi/hr.

meridional motion is established, to infer the vertical motion. Thus there is upward motion on the equatorward side of the low-latitude meridional cell, sinking motion on its poleward side, and again upward motion on the poleward side of the mid-latitude cell. These motions are probably not more than about 1 mm/sec at their maximum !

The mean motions over the polar caps are not well established but this is of no great consequence for the immediate purpose because the area of the polar caps is so small a fraction of the total area of the earth.

*The turbulence*

The turbulence associated with the above mean motion comprises a great range of scale, in space and time, and, at the expense of oversimplification, I shall make a rough differentiation between different parts of the spectrum. At the upper end of the scale there are the so-called long waves of the westerlies (Fig. 2), some 5,000 to 10,000 km

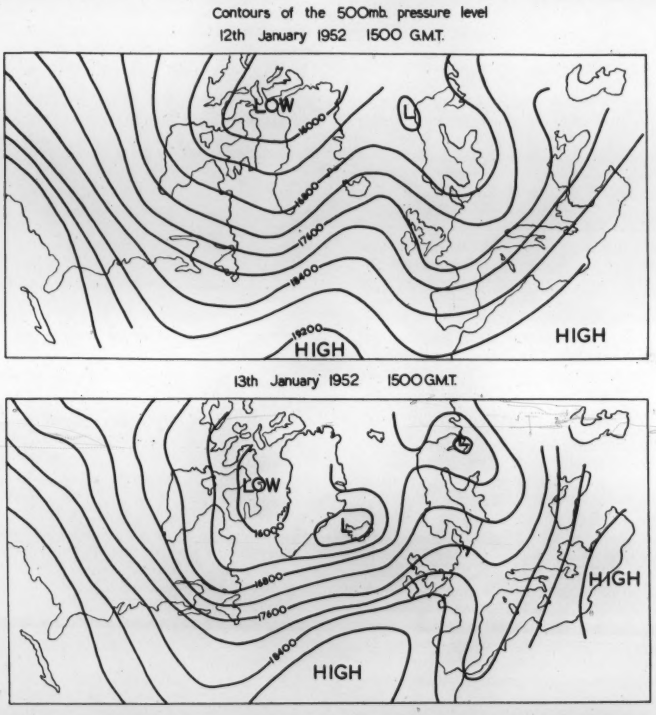



Fig. 2. *An example of long waves in the North America-Atlantic-Europe sector on successive days, January 12 and 13, 1952. The lines, drawn at 200 ft. intervals of height, show the topography of the 500 millibar surface, which slopes generally downward towards the pole. The wind blows nearly along the contours and is inversely proportional to their separation and to the sine of the latitude. Note the tendency for the troughs and ridges to slant from east of south to west of north. The separation of observing stations and the method of analysis result in the broadscale flow only being apparent.*

in horizontal wavelength and roughly the depth of the troposphere in vertical wavelength. There is commonly a jet stream embedded in the upper levels of the wave, in which the wind velocity may reach 100 m/sec or more.* Passing downwards in scale we have the frontal depressions and associated ridges of middle and high latitudes, convective cloud motions of cumulus and cumulonimbus, and so to the small-scale turbulence evident in the spread of smoke from a chimney near the ground and in the bumpiness occasionally experienced by aircraft in the region of a jet stream.

Certain of the observed features of this complex of motions are appropriately referred to. Thus, the motion in the long waves and in large depressions and anticyclones is nearly horizontal, as implied by the ratio of the vertical to the horizontal scale, the vertical velocities being a few cm/sec only. These motions are effective in the horizontal and vertical transfer of heat, water-vapour and momentum. Convective cloud systems on the other hand develop substantial vertical motions, of order 5 m/sec, over substantial depths of atmosphere, and they are particularly effective in vertical transfer. Small-scale turbulence is mostly evident where there is a large shear of wind in not too stable a temperature stratification, as often near the earth's surface. It promotes transfer normal to this surface (near which large-scale turbulence is necessarily very weak in vertical component) and effects the dissipation of kinetic energy of the larger-scale motions into heat.

Only in the broadest sense is it possible to regard the spectrum of atmospheric turbulence as an equilibrium spectrum, in adjustment with the mean flow. The turbulence is very inhomogeneous and the form of the spectrum is probably highly variable, except on a very long-term basis.

### 3. SOME SIMPLE INFERENCES AND FURTHER FACTS

Given the above picture of mean and turbulent motion in the atmosphere, we can immediately make a few simple but important inferences. Thus the surface westerlies, by surface friction (small-scale turbulence and mountain drag), impart westerly momentum to the underlying earth, whereas the surface easterlies extract westerly momentum from the underlying surface by the same mechanism. But the earth, year by year, rotates at a constant angular velocity, to the accuracy relevant to the present context, so that the frictional torque of the westerlies about the earth's axis must on average be equal and opposite to the frictional torque of the easterlies. This is an important boundary constraint to the general circulation and implies, of course, that surface easterlies must be accompanied by surface westerlies.

Again, there can be no net zonal pressure force on a continuous ring of air round a latitude circle. Westerly angular momentum is however drained continuously by friction from the ring of air surmounting the surface westerlies and injected continuously into the ring of air surmounting the surface easterlies, yet the mean motion in each ring is maintained. Westerly angular momentum must therefore be exported from the ring with surface easterlies to the ring with surface westerlies, i.e. across the vertical surface at about 30° latitude (we neglect here the influence of the polar cap on account of its small area and short axial distance). This poleward transfer of westerly momentum may be brought about in principle either by the mean meridional motion (a product $\rho UV$ is involved where $\rho$ is the air density) or by turbulence (a product $\rho\overline{uv}$ is involved, where $u$, $v$ are departures of the actual motion from the corresponding mean motion $U$, $V$ and the bar signifies a mean). Now our routine observations of wind enable us to compute the meridional transfer of westerly momentum by the larger-scale turbulence and mean motion and it is found (Fig. 3) that, at about 30°N, the transfer is indeed poleward, is of about the right amount to balance the surface stresses—to the accuracy that we know them—and is effected almost entirely by the large-

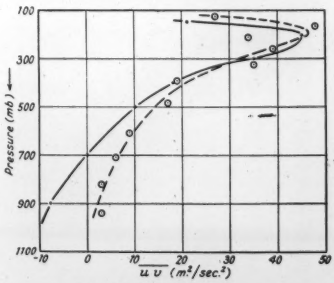



Fig. 3. *Meridional transport of angular momentum by large-scale turbulence* ($\propto \overline{uv}$) *as a function of height* (*pressure*) *across a latitude circle at about 30°N. The dots and circles refer to independent evaluations by different workers.*

* The jet streams of the disturbed flow are not to be confused with the sub-tropical jet of the mean flow. The former migrate, intensify and decay, and so fail to appear in the smoothed flow ; laboratory experiments suggest that they might be a more stable feature of flow over a uniform earth.

scale turbulence. The transfer is poleward also at other latitudes, up to about 60°N (Fig. 4), and necessarily falls off to south and north of 30°N because of the pattern of surface wind and stress. Only within the tropics does the transfer by mean motion appear to be comparable with that by the turbulence. We infer therefore that the observed pattern of mean zonal motion is not to be accounted for without reference to the existence and properties of the large-scale turbulence.* This inference was first drawn by Jeffreys many years ago but only within the last few years has it been possible to establish the facts as elaborated above.

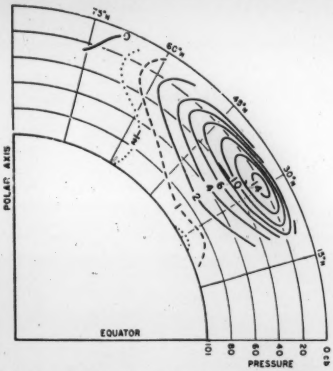



Fig. 4. *Isopleths of the meridional transfer of angular momentum by large-scale turbulence in a mean meridional cross-section for January, 1949. The isopleths are labelled in arbitrary units. Note that the pattern of transfer is broadly the same as the pattern of mean zonal wind (cf. Fig. 1, Winter) so that the pattern is related to the zonal wind itself rather than to meridional gradient of the zonal wind. (After Mintz.)*

It is evident from Figs. 3 and 4 that the meridional transfer of westerly momentum occurs mainly in the high troposphere—where the large-scale turbulence is most intense. But the frictional source and sink of momentum are at the earth's surface. We are then left to discover and explain how the momentum is transferred from the upper to the lower level, or the reverse. Or we may ask how zonal momentum is created in some levels and destroyed in others. Now, a poleward mean motion creates westerly momentum—the familiar Coriolis acceleration—and an equatorward mean motion destroys it, or creates easterly momentum. The senses of the tropical and mid-latitude cells (§ 2) are consistent with the momentum balance being achieved in this way but the vertical transfer of momentum by turbulence has to be fitted into a self-consistent scheme. The problem is difficult to resolve by observation because more sophisticated techniques than are commonly available are required for the measurement of vertical motions, especially in cloud.

### 4. TOWARDS A THEORY

The pattern of mean and turbulent motion and of momentum transfer given above provide, with some gaps, a more or less self-consistent description of the general circulation, but it is not thereby "explained." Significant progress has been made towards a quantitative theory as evidenced by a recent numerical experiment by Phillips at Princeton. He integrated the (non-linear) hydrodynamical equations of motion for a simplified, two-layer model of the atmosphere, initially taken to be at rest, and thereby predicted its evolution over a period of 160 days, obtaining thoroughly realistic fields of flow. But the physicist is hardly content to be told that the explanation of a particular field of motion resides in the well-known differential equations of motion, together with the equations of conservation of energy and of mass and appropriate boundary conditions. He likes to have a knowledge of process and in the space remaining to me I shall summarize in a crude, qualitative way one man's present understanding of the system.

All atmospheric motion derives ultimately from the non-uniform heating of the earth and its atmosphere by solar radiation. With this distributed source of heat—the boiler—goes a field of cooling brought about by the radiation of the earth's atmosphere to space—the sink or condenser. But the thermodynamic engine thus constituted does no net work ; it merely transforms energy from short to long wave electromagnetic radiation through the agency of the winds, which are continuously generated by the engine and which are simultaneously dissipated by internal friction. Moreover, the system is so full of feed-back processes that there is no *given* system on which the fields of solar and terrestrial radiation may be said to operate. For the winds which derive from the thermal sources and sinks produce clouds and these control the amount and distribution of solar

* The form of the mean velocity profile in turbulent flow through a tube is also of course dependent on the properties of the turbulence. But the meteorological case is more subtle, for there is no pressure gradient in the direction of the mean zonal flow whereas there must be a pressure gradient along the tube.

radiation reflected from the earth and of radiation emitted by the atmosphere. The winds also distribute water - vapour, carbon - dioxide and ozone, which control the radiative power of the air, and they distribute heat, i.e. enthalpy, which further controls the radiative power of the air. Thus the atmosphere goes some way towards disposing its own sources and sinks of heat. This intricate feed-back must be kept in mind in the following argument which only recognizes its existence in the sketchiest fashion.

An atmosphere at rest with respect to the earth would be practically in radiative equilibrium. If its chemical composition were the same as that observed (an impossible condition—but our argument, unlike the real atmosphere, needs a starting point !) it would have a lower layer, equivalent to the troposphere, in which temperature decreased upwards and polewards. Above, there would be a layer, equivalent to the stratosphere, in which both the meridional and vertical gradients of temperature would be reversed, because of the existence of ozone aloft with a maximum concentration over the polar caps. In both layers, however, the meridional and vertical gradients would be substantially larger than those we in fact observe. Now the pressure, which is the weight of the superincumbent atmosphere, must decrease with height, but it will decrease more slowly where the temperature is higher so that in the troposphere the isobaric surfaces would slope downwards from equator to pole, the slope increasing with height. In the stratosphere, with its reversed meridional gradient of temperature, the slope of the isobaric surface would diminish with height.

To progress from statics to dynamics, the vertical lapse of temperature in the troposphere and the meridional gradient of pressure would both give rise to motion and destroy the state of radiative equilibrium assumed. The unstable lapse-rate would give rise to convection, with greater intensity in lower latitudes, and both the vertical and meridional gradients of temperature would be diminished thereby. The meridional gradient of pressure would give rise to a circumpolar westerly vortex, most intense at the top of the troposphere where the isobaric slope is greatest. For, on this scale, atmospheric motion must become, as we say, quasi-geostrophic, with the wind very nearly parallel to the isobars, in which condition a state of near-balance is achievable between the Coriolis force on the zonal component of the motion and the meridional pressure gradient. The picture is consistent with the observed increase of westerlies with height in the troposphere and their decrease with height in the stratosphere (Fig. 1) but it leaves unaccounted the surface wind field and the non-uniform westerlies aloft, i.e. the sub-tropical jet. Both the latter features are undoubtedly related to the existence of turbulence whose origin and nature we must now briefly examine.

The *observed* lapse-rate in the troposphere is in general too small to promote large-scale vertical overturning of the air, the condition being equivalent to density decreasing with height in an incompressible fluid. (Locally and temporarily the lapse-rate may be large enough for overturning, and cumulus or cumulonimbus may result.) Thus the lapse-rate is even less than that which would result from the operation of convection on a field initially in radiative equilibrium and in itself necessarily represents a departure from radiative equilibrium, so that sources and sinks of heat are implied. The source is in the lower levels of low latitudes and elsewhere the troposphere is a sink, so that heat must be transported upwards and polewards by the winds. Any satisfactory theory of the general circulation must demonstrate the necessity of the observed stable lapse-rate but for the moment we assume the condition to exist. We then ask how such an atmosphere with temperature also decreasing polewards (or zonal wind increasing with height) may become turbulent and we find that it may do so by overturning in surfaces of very gentle slope, and that there is a maximum rate of generation of kinetic energy when the horizontal scale of the overturning is of order a few thousand kilometres. The theory of this thermal sort (as of other sorts) of turbulence is not yet well developed but it is easy to see that energy can be released by the process. For, regarding the atmosphere for the

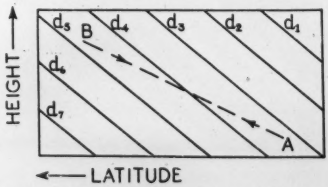



Fig. 5. *Model to illustrate the development of large-scale slant-wise convection in the atmosphere. In the equivalent incompressible atmosphere the density decreases upwards and polewards as shown by the lines of constant density* $d_1$, $d_2$ . . . ($d_1 < d_2 <$ . . . ). *A parcel of air displaced upwards and polewards from A on a slope AB less than that of the d lines moves into a field of higher density and is accelerated. Similarly a parcel moving downwards from B along BA is also accelerated.*

moment as incompressible (the argument for a compressible atmosphere is readily adapted), the equivalent distribution of density in a meridional plane can be represented, as in Fig. 5, by lines of constant density (isopycnics) which slope upwards and polewards. A particle of air displaced vertically upwards would find itself in an environment of lower density and so would sink back but if the particle were displaced polewards as well as upwards *on a slope less than that of the isopycnics*, along AB say, it would find itself in an environment of increasingly greater density and so would be subject to increasing buoyancy. Similarly a particle displaced from B towards A would be accelerated downwards along BA. "Particle theory" is no substitute for hydrodynamics but the possibility of energy release is evident. Eady has shown by solution of the hydrodynamical equations that the fields of temperature and wind which can develop by "slantwise convection" are essentially those which we observe in the troughs and ridges of mid-latitude disturbed westerlies. The process is one of large-scale stirring of the atmosphere in which, evidently, the horizontal and vertical gradients of temperature or density are likely to be greatly intensified in preferred regions. These regions are the frontal zones of depressions though theory has not yet accounted for their extreme sharpness, which is probably related to condensation. (It is to be noted that stirring does not smooth out differences on all scales. The scale of stirring has to be considered.)

We have thus arrived at some understanding of the large-scale turbulence of the atmosphere and are able to see that it is fundamental to most aspects of the general circulation. For example, it should and does transfer heat upwards and polewards, thus satisfying the thermodynamic requirement. It also goes some way towards creating and maintaining the generally stable lapse-rate which, with the poleward temperature drop (which it minimizes), is the reason for its existence and was the starting point in our discussion. Meridional circulations must also affect the temperature field but they themselves are partly, at least, the result of friction, that is of turbulence, though all scales are involved. The local areas of unstable lapse-rate are also largely the product of large-scale turbulence, permitting local fields of cumulus and cumulonimbus to develop.

The poleward transfer of zonal momentum in the westerlies aloft (§3) has been qualitatively accounted for in that the axes of troughs and ridges in the upper westerlies should and do trail backwards, from NE to SW (*cf.* Fig. 2), making $\rho\,\overline{u'v'}$ positive. The surface wind field, a residual feature of the circulation, is now prescribed. For the transport $\rho\,\overline{u'v'}$ aloft is a property of the large thermal eddies and must be poleward, so that zonal momentum must be injected into the atmosphere in lower latitudes and extracted in higher latitudes. This may only happen with surface easterlies and westerlies in the respective zones.

The existence of a sub-tropical jet in the mean flow is not yet adequately explained. Large-scale turbulence would probably give rise directly to a maximum zonal wind aloft in somewhat higher latitude by an appropriate concentration of the meridional temperature gradient. Some equatorward shift of the maximum is, however, to be expected by the poleward and equatorward mean motions of tropical and mid-latitude upper levels, but numbers here, as elsewhere, in the theory only just begin to appear.

## EPILOGUE

We have discussed the general circulation as if it were a long-term steady state, and it is indeed appropriate to obtain quantitative understanding of such a state. But the general circulation of the atmosphere is itself subject to more or less slow variation, from decade to decade, century to century, ice age to ice age, with intensifications and shifts in the patterns of thermal gradient and precipitation. Once we have a reasonably precise understanding of the circulation as it "now" is, there is scope for inferring how it may evolve, which is a matter of tremendous economic importance as well as of scientific interest. We may guess that changes in the distribution of sea-temperature—another, wider aspect of feed-back—with consequent changes in water-vapour amounts, are likely to be the most potent sources of change because of the large thermal capacity of the sea and its changes of property when frozen. But at present we lack empirical evidence and theory is not sufficiently advanced. I hope I have said sufficient, in a sufficiently clear manner, to indicate that there is a challenging but hopeful future for the student of the general circulation.

# *Forthcoming Institute Meetings*

**April 28** Electronics Group At the Royal College of Science, Imperial College, London, 4 p.m.

**"Permeation of Gases through Solids"**

DR. F. J. NORTON

(*Research Laboratory, The General Electric Company, Schenectady, New York*)

**April 29** Midland Branch and Electronics Group

In the Priory Lodge Hall, Winter Gardens, Malvern, 10.30 a.m.

Joint one-day symposium on

**"Some Applications of Solid State Physics in Computers and Automation"**

Application forms available from the Institute.

**May 2** Liverpool and North Wales Branch

In the Department of Electrical Engineering, University of Liverpool, 7 p.m. Tea 6.30 p.m.

**"The Physical Basis of Life"**

PROFESSOR J. D. BERNAL, F.Inst.P., F.R.S.

(*Birkbeck College, London*)

**May 5** North Eastern Branch

At Science Laboratories, University of Durham, 5.15 p.m. Tea 4.45 p.m.

Joint meeting with

Durham Colleges Physical Society

**"Radio Astronomy"**

DR. J. R. SHAKESHAFT

(*Mullard Radio Astronomy Observatory, Cambridge*)

**May 14** Stress Analysis Group At the Institute's House, 10 a.m.—6 p.m.

**"Contact Stresses"**

**May 16** Non-Destructive Testing Group jointly with the Acoustics Group of The Physical Society

**"The Characteristics and design of Ultrasonic flow-detection transducers"**

D. G. CHRISTIE

(*Aluminium Laboratories Ltd., Banbury*)

**May 17** Yorkshire Branch

Summer Meeting

**Visit to the University of Hull**

(Application forms available from the Institute)

# The Register

## ELECTIONS TO MEMBERSHIP

THE FOLLOWING ELECTIONS WERE MADE BY THE BOARD ON MARCH 4, 1958

*An asterisk (*) indicates transfer from another grade*

### FELLOWS

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*Trott, Nigel Graham, B.Sc., Ph.D., Physicist, Institute of Cancer Research, Royal Cancer Hospital, London.

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Noe, Edwin Henry, B.Sc., Signals Officer, Royal Air Force.
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Worsley, Ronald Edward, B.Sc., Development Physicist, The Plessey Co. Ltd., Towcester, Northants.
Worthington, Peter John, B.Sc., Research Student, University of Sheffield.

Ninety-four Students and four Subscribers were also elected.

# *The Institute's Journals*

## PRINCIPAL CONTENTS OF THE APRIL, 1958, ISSUES

### *Journal of Scientific Instruments:* Volume 35, No. 4

**ORIGINAL CONTRIBUTIONS**

**An improved Czochralski crystal-pulling furnace.** By K. H. J. C. Marshall and R. Wickham.

A furnace suitable for pulling single crystals of germanium and silicon has been made. This apparatus differs from previous designs in that it combines rapidity of set-up with ease of operation and almost perfect vision during the crystal-growing cycle. The heating element is of resistance heated graphite and provision is made for growing either in vacuum or in an inert gas atmosphere.

**An a.c. velodyne integrator.** By J. B. Sharp and R. W. Williams, A.Inst.P.

An electromechanical integrator is described which is an a.c. version, operating with 50 c/s signals, of the well-known velodyne principle. The difficulties peculiar to the a.c. velodyne are summarized and the features of the design, by which these are overcome, are indicated. The accuracy of integration is discussed, with special reference to the errors caused by Coulomb friction, to transient response and to temperature effects. Integrators of the type described have given satisfactory service for some years in a large special-purpose analogue computer.

**The flash photography of a deep field of view.** By F. de S. Barros, D. M. Binnie and B. D. Hyams.

An optical arrangement for the photography of deep fields of view is described. It involves the illumination of successive strips of the object space and the use of a weak auxiliary lens of variable focal length. The variable lens refocuses in about 2 ms.

**A simple instrument for the periodic application of controlled bi-axial strains.** By P. U. A. Grossman. A.Inst.P.

This instrument produces harmonically varying strains in a thin layer of a test material and controls in two dimensions the frequencies, amplitudes and phases. Weissenberg's method of a flexible boundary is employed to obtain homogeneous strain and a uniform break-up pattern when fatigue failure is approached. The specimen adheres to the surface of a rubber sheet which is extended in two directions by sets of parallel strings fastened to sliding carriages. The carriages follow circular cams, one directly and one through a lever. The cams are inter-connected by a chain and rotated in rigidly located bearings by hand or motor. Any phase difference is readily set by positioning the chain wheels, and any ratio of amplitudes by shifting the fulcrum of the lever. A ratio of frequencies can be selected by choosing appropriately sized chain-wheels. To illustrate the applications, the fatigue of powders under various testing conditions is described and the emergent break-up patterns are discussed.

**An automatic quartz-fibre electrometer.** By M. C. B. Russell and J. Leng.

A quartz-fibre electrometer with ancillary equipment is described, whereby an average rate of change of potential may be determined with probable errors of about $\pm 0{\cdot}2$ mV in the change of potential, and $\pm 0{\cdot}02$ s in the measurement of time. An instrument for automatic recording of β-activity within the range $0{\cdot}04$ to 30 μc is described in detail with experimental results.

**Decade flux linkage generators.** By T. M. Palmer.

A description is given of two versions of a self-contained instrument for calibrating flux-meters and ballistic galvanometers. In both, a known constant flux-change is produced by reversing the primary current in a saturated inductor. The desired linkage is then obtained by switching the appropriate number of secondary turns into circuit. Two saturable inductors provide a total flux-linkage change of $11{\cdot}11 \times 10^6$ Maxwell-turns in four decades.

**A recording double-beam attachment for the Unicam type SP500 spectrophotometer.** By J. L. Hales.

A review is made of published accounts of double-beam attachments for spectrophotometers, for use in the visible and ultra-violet region. A simple alternate-path unit, incorporating a single type I.P.28 photo-multiplier detector, is described. A ratio-recording amplifying system is employed, and the spectrometer slit width is monitored by a servomechanism to give a constant "reference" output from the amplifier. A compact wavelength drive is incorporated.

### *British Journal of Applied Physics:* Volume 9, No. 4

**SPECIAL ARTICLE**

**The mechanical wear of metals.** By W. Hirst, F.Inst.P.

The design of fundamental experiments for examining the wear phenomena encountered in the conditions of speed and loading of industrial machines is discussed. Apparatus is described in which nominal point or nominal line contact can be maintained indefinitely, and some of the phenomena observed when a lubricant is used are discussed. With carefully run-in specimens, the hydrodynamic condition of lubrication is

maintained up to very heavy loads; a method of measuring the thickness of the oil film in line contact conditions is outlined and some results given. In unlubricated conditions the phenomena of wear can be studied using simpler equipment. The main phenomena, the laws and the mechanisms of wear in unlubricated conditions are discussed, and the present state of development of theories of wear is outlined. In conclusion, some suggestions are made about the directions in which fundamental studies of wear need to be pursued.

## ORIGINAL CONTRIBUTIONS

**The geometry of twisted multi-filament structures.** By G. J. Stansfield.

A self-consistent geometry of cords made from multi-filament yarns is derived from the assumption that all filaments in a cord follow an epihelical path. This path is defined mathematically using a definition of ply twist not considered before, which leads to simpler formulae than those developed by previous workers. Formulae for changes in ply length, ply twist and cord length on cording are derived which enable the retraction of cords and yarns on twisting to be predicted accurately. An experimental method of cord twisting (simple twisting) is described which enables a simple experimental verification of this theory of twist to be carried out.

**Beam temperature, discharge lag and target biasing in some television pick-up tubes.** By B. Meltzer, F.Inst.P., and P. L. Holmes.

Discharge lag in pick-up tubes, particularly of modern cathode-potential-stabilized type, and its relation to the acceptance of the electron beam by the target are analysed. Measurements of beam acceptance as a function of target potential reveal effective beam temperatures substantially equal to cathode temperature at low beam currents, but higher and multi-valued at high currents. These temperatures set a limit to the possible reduction of lag wthout target biasing ; this limiting lag, referred to as Maxwellian lag, is calculated and presented graphically. Direct measurements of lag are compared with the limiting values. Target biasing, the application of a small positive potential to the target face, reduces this limitation. Results of electron-optical measurements, throwing some light on the anomalous beam temperatures, are presented.

**An electrical analogue method of predicting the permeability of unsaturated porous materials.** By M. C. Probine.

The manner in which the permeability of unsaturated porous materials varies with moisture content has been investigated, using an electrical analogue technique. The hydraulic resistance of a water channel in the porous material has been represented by an electrical resistor, and the three-dimensional network of channels by a corresponding three-dimensional resistance network. With all the resistors in circuit the electrical resistance across opposite faces of the network is assumed to be inversely proportional to the saturated permeability. Empty channels are not effective in transporting liquid so that drying of the material is simulated by progressively removing resistors representing the largest of the remaining water-filled channels. In this way the decreasing permeability of the material as it dries out can be related to its moisture content. The predictions by the analogue method agree very well with the experimentally determined values.

**A sintered nickel matrix cathode.** By R. W. Fane, A.Inst.P.

A study of a cathode containing alkaline earth carbonates and boron has shown that lives of at least 8,000 hours may be obtained at d.c. current densities in excess of $\frac{1}{2}$ A/cm$^2$. The cathode also exhibits good pulse emission properties. Processing schedules and operating temperatures are similar to those of a normal oxide-coated cathode. Experiments carried out in an attempt to elucidate the mechanism of operation are described.

**The evaporation of sprays.** By R. T. Jarman, A.Inst.P.

The rate of evaporation of an aircraft spray of kerosene droplets in the atmosphere has been measured, and was found to approximate to the theoretical estimates.

**Measurements on the air-nuclei in natural water which give rise to cavitation.** By K. S. Iyengar and E. G. Richardson.

Measurements are described on the detection by physical means of the gaseous nuclei in water which are responsible for the water cavitating when the pressure is reduced. For measuring the critical pressures for cavitation an ultrasonic excitation is used. To estimate the size and number of the nuclei, methods based on the reverberation and optical scattering are used. The changes in cavitation potential of aerated water with time and the effect on the nuclei of subjecting the water to prolonged excess pressure are described.

**Measurements of pressure distribution between metal and rubber covered rollers.** By G. J. Parish.

Measurements of pressure distribution in the nip between a metal roller and a roller consisting of a thin rubber cover on a metal shell under various conditions of load, cover hardness and cover thickness are described. The results, although in qualitative agreement with Hannah's theory, show appreciable deviations from the quantitative theoretical predictions, and the possible causes of this discrepancy are discussed.

**A method for determining $^{24}$Na and $^{42}$K when present together in liquid samples.** By M. P. Esnouf.

A simple method has been described for the separate determination of $^{24}$Na and $^{42}$K in liquid samples, which is based on the differential absorption of β-particles. The relative concentrations of the isotopes are estimated from the difference in the observed counting rates of a sample when it is measured in a type M6 tube and in a modified M6 tube. Details are given for the necessary modification of the M6 tube.

# *Report of the Board of The Institute of Physics for the year 1957*

TO BE PRESENTED FOR ADOPTION AT THE ANNUAL GENERAL MEETING OF THE INSTITUTE ON JULY 1, 1958

## The Board and its Committees

The present Board took office on October 1, 1957 ; its members on December 31, 1957, were :

*President :* Mr. O. W. Humphreys.

*Immediate Past-Presidents :* Dr. C. Sykes, Sir John Cockcroft.

*Vice-Presidents :* Dr. W. H. Taylor, Dr. B. P. Dudding, Professor E. A. Owen, Professor E. C. Stoner.

*Honorary Treasurer :* Dr. J. Taylor.

*Honorary Secretary :* Professor F. A. Vick.

*Ordinary Members of the Board :* Dr. M. R. Hopkins, Dr. J. M. A. Lenihan, Dr. K. A. G. Mendelssohn, Mr. F. Oldham, Mr. H. P. Rooksby, Dr. J. Thewlis, Dr. L. R. G. Treloar, Mr. G. W. Warren.

*Chairmen of Branches in Great Britain :* Professor E. A. Owen (Liverpool and North Wales), Dr. J. S. Forrest (London and Home Counties), Dr. R. W. Sillars (Manchester and District), Dr. R. E. Bastick (Midland), Dr. O. P. T. Kantorowicz (North-Eastern), Mr. R. M. Sillitto (Scottish), Professor R. M. Davies (South Wales), Professor S. H. Piper (South-Western), Professor W. Sucksmith (Yorkshire).

*Representing The Physical Society :* Dr. H. H. Hopkins and Dr. D. A. Wright.

During the year the Board met five times and appointed the undermentioned Standing and Executive Committees which held thirteen meetings.

*Finance and General Purposes Committee* (*Chairman :* The Treasurer).

*Membership and Examinations Committee* (*Chairman :* Dr. W. H. Taylor).

*Benevolent Fund Committee* (*Chairman :* Dr. J. Taylor).

*Advisory Committee of the British Journal of Applied Physics* (*Chairman :* Dr. J. M. A. Lenihan).

*Advisory Committee of the Journal of Scientific Instruments* (*Chairman :* Dr. K. A. G. Mendelssohn).

*Advisory Editorial Board* (*Chairman :* Professor F. A. Vick).

*Meetings Committee* (*Chairman :* The President).

*Physics of Nuclear Power Committee* (*Chairman :* The President).

## Representatives and Nominees on Joint Committees and other Bodies

The Institute has been represented as follows and summaries of the principal work of those bodies likely to be of interest to members are given in the appendix to this Report.

*On The Royal Society's National Committee for Physics :* Professor F. A. Vick.

*On The Royal Society's National Committee for Crystallography :* Dr. W. H. Taylor.

*On The Royal Society's Paul Instrument Fund Committee :* Sir Frank Smith.

*On the Board of The British Nuclear Energy Conference :* The President, Sir John Cockcroft and Dr. H. R. Lang.

*On the Joint Council of Professional Scientists :* Professor F. A. Vick, Dr. J. Taylor and Dr. H. R. Lang.

*On the Parliamentary and Scientific Committee :* Professor F. A. Vick and Dr. H. R. Lang on the General Committee, together with Dr. J. S. Forrest and Dr. J. Taylor at the Annual Meeting.

*On the Committee of Management of Science Abstracts :* Dr. L. R. G. Treloar.

*On the National Council for Technological Awards Board of Studies in Technologies other than Engineering :* Professor F. A. Vick.

*On the City and Guilds of London Institute's Advisory Committee on Courses for Laboratory Technicians :* Mr. N. Clarke, Mr. T. H. Tyler and Mr. L. Walden.

*On the City and Guilds of London Institute's Advisory Committee on the Training of Instrument Mechanics and Technicians :* Mr. N. Clarke.

*On the City and Guilds of London Institute's Advisory Committee on Industrial Radiography :* Mr. N. Clarke, Mr. F. Y. Poynton and Mr. W. E. Schall.

*On the Joint Committee with the Ministry of Education for National Certificates in Applied Physics :* Dr. J. S. Forrest, Mr. A. E. De Barr, Mr. A. T. Pickles and Dr. J. Topping.

*On the Joint Committee with the Scottish Education Department for National Certificates in Applied Physics :* Mr. T. H. O'Beirne, Dr. J. M. A. Lenihan and Dr. R. S. Silver.

*On the British Committee for Radiological Units :* Mr. W. Binks.

*On the Joint Committee (with The American Society for Testing Materials and The American Crystallographic Association) for Chemical Analysis by X-ray Diffraction Methods :* Professor A. J. C. Wilson.

*On the Ministry of Labour and National Service's Panel on Special Regulations for Protection against Ionizing Radiations :* Mr. H. P. Rooksby, Mr. W. E. Schall.

*On the British Group for Computation and Automatic Control of the British Conference on Automation and Computation :* Dr. A. D. Booth and Mr. N. Clarke.

*On the British National Committee for Non-Destructive Testing :* Dr. J. Thewlis.

*On the Program Sub-Committee of the International Convention on Microwave Valves :* Professor M. R. Gavin.

*On the Court of Governors of Manchester College of Science and Technology :* Dr. R. W. Sillars.

*On the Court of the University of Hull :* Dr. E. C. Craven.

*On the Court of the University of Exeter :* Professor S. H. Piper.

*On the Governing Body of Croydon Technical College :* Mr. C. L. S. Gilford.

*On the Governing Body of Norwood Technical College :* Dr. A. J. Maddock.

*On the Governing Body of Brunel College of Technology :* Mr. E. R. Davies.

*On the Governing Body of Rutherford College of Technology :* Mr. G. N. Peel.

*On the Governing Body of the Welsh College of Advanced Technology, Cardiff :* Dr. H. O. Puls.

*On the Advisory Committee for Applied Physics of the London and Home Counties Regional Advisory Council for Higher Technological Education :* Mr. N. Clarke, Mr. F. Y. Poynton and Mr. G. W. Warren.

*On the Science Advisory Sub-Committee of the Regional Council for Further Education for the South West :* Professor S. H. Piper.

*On the Advisory Sub-Committee for Electrical Engineering and Applied Physics of Cardiff College of Technology and Commerce :* Mr. R. G. Wood.

*On the Sub-Committee on Specialist Courses in Electrical Engineering of the Welsh Academic Board of Technology :* Mr. W. S. Vernon.

*On the Consultative Committee for Electrical Engineering and Applied Physics of the South East London Technical College :* Dr. C. G. Wynne.

*On the Applied Science Advisory Committee of Birmingham College of Technology :* Mr. M. Milbourn.

*On the Science Advisory Committee of Blackburn Municipal Technical College :* Dr. R. Schnurmann.

*On the Science Advisory Committee of Bournemouth Municipal College of Technology and Commerce :* Mr. A. F. Blaylock.

*On the Science Advisory Committee of Bury Municipal Technical College :* Mr. H. Potter.

*On the Science Advisory Committee of Croydon Technical College :* Mr. S. Hill.

*On the Science Sub-Committee of the Eastern Area Technological Committee of the East Anglian Regional Advisory Council for Further Education :* Mr. H. A. Nancarrow.

*On the Science Advisory Committee of Ewell County Technical College :* Dr. J. S. Forrest.

*On the Council for Science of Ipswich Civic College :* Mr. H. A. Nancarrow.

*On the Advisory Committee for Applied Physics of Kingston Technical College :* Dr. G. D. Robinson.

*On the Science Advisory Committee of Luton and South Bedfordshire College of Further Education :* Dr. R. W. Williams.

*On the Science Advisory Committee of Merseyside District Advisory Council for Further Education :* Professor J. D. Craggs.

*On the Science Advisory Committee of Northampton College of Technology :* Dr. J. T. Kendall.

*On the Science Advisory Sub-Committee of Poole College for Further Education :* Mr. C. F. Oxbrow.

*On the Applied Science Advisory Committee of the Royal Technical College, Salford :* Mr. D. A. Crooks.

*On the Science Advisory Committee of Slough College of Further Education :* Mr. J. Yarwood.

*On the Science Advisory Committee of Southend-on-Sea Municipal College :* Mr. N. Clarke.

*On the Advisory Committee for Physics of West Ham College of Technology :* Mr. L. V. Chilton.

*On the Applied Science Advisory Committee of the Wolverhampton and Staffordshire College of Technology :* Dr. D. E. C. Corbridge.

*On the Yorkshire Council for Further Education Advisory Panel for Physics :* Dr. M. McCaig, Mr. D. F. Burnett, Mr. B. O. Payne, Dr. E. C. Craven.

*On British Standards Institution Committees :* The Institute has been represented on twenty-two Committees of the B.S.I.

**General Meeting**

The 27th Annual General Meeting of the Institute was held on July 12 in Oxford.

**Membership**

During the year 795 applications for election or transfer to the various grades were received for submission to the Membership and Examinations Committee, compared with 752 applications in 1956. The numbers for the grades (with the 1956 numbers in brackets) were : Fellows 68 (64), Associates 246 (297), Graduates 254 (238), Students 212 (128), Subscribers 15 (25). The Interview Panel met twice and interviewed ten

candidates. Representatives of the Committee visited nine technical colleges which had applied for recognition by the Institute.

The continued growth of the Institute is shown in the following table.

Table 1

*Growth of the Institute over the last ten years*

| | | | | | |
|---|---|---|---|---|---|
| 1948 | ... | 3455 | 1953 | ... | 4595 |
| 1949 | ... | 3657 | 1954 | ... | 4749 |
| 1950 | ... | 3858 | 1955 | ... | 5146 |
| 1951 | ... | 4080 | 1956 | ... | 5531 |
| 1952 | ... | 4347 | 1957 | ... | 5881 |

The changes that have occurred during the year are displayed in Table 2.

*Deaths.* The Board records with regret the deaths in 1957 of :

*Fellows:* J. C. Bower, B. Davies, H. R. Heath, T. G. Hodgkinson, G. E. Foxwell, J. A. Nye. *Associates :* A. Lodge, S. Muntaz-ud-din, D. J. Thomas, J. S. Wilson. *Graduates :* L. S. Arthur, W. C. Lewis, J. C. Philips. *Subscribers :* D. J. Adshead, W. Cartwright, P. Grodzinski. *Student :* K. F. Wiles.

Table 2. *Changes in the Register in 1957*

| | *Total on Dec. 31, 1956* | *Elections* | | | *Resigned* | *Deceased* | *Removed* | *Transfers from* | *Net Increase or Decrease* | *Total on Dec. 31, 1957* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *New* | *Transfers to* | *Re-admitted* | | | | | | |
| Hon. Fellows | 7 | — | — | — | — | — | — | — | — | 7 |
| Fellows ... | 1042 | 15 | 38 | — | 1 | 7 | — | — | + 45 | 1087 |
| Associates ... | 2211 | 122 | 97 | — | 11 | 3 | 7 | 38 | +160 | 2371 |
| Graduates ... | 1195 | 159 | 68 | — | 12 | 3 | 10 | 97 | +105 | 1300 |
| Subscribers... | 470 | 12 | 1 | — | 16 | 2 | 11 | 1 | − 17 | 453 |
| Students ... | 606 | 202 | — | — | 19 | 1 | 57 | 68 | + 57 | 663 |
| TOTAL... | 5531 | 510 | 204 | — | 59 | 16 | 85 | 204 | +350 | 5881 |

## Examinations

*Graduateship Examination.* The Graduateship Examination was held on June 3–7. Written papers were taken at the Institute's House, the College of Technology, Birmingham, Paisley Technical College, the Royal Technical College, Salford, and the Technical College, Swansea. The practical examination was held at The Polytechnic, Regent Street, London, and at the Royal Technical College, Salford. The papers were published in the August *Bulletin* with the comments of the examiners and were subsequently published in pamphlet form.

The examination was taken by sixty-eight candidates (there were forty-five in 1956) and twenty-one satisfied the examiners (compared with seven in 1956). Fifteen question papers were set. The examiners were : Mr. N. Clarke, Mr. A. E. De Barr, Mr. R. F. Farr, Dr. A. W. Gillies, Professor H. Lipson, Mr. A. T. Pickles, Mr. E. D. van Rest, Dr. R. Schnurmann, Dr. C. A. Taylor, Professor J. G. Wilson and Mr. J. Yarwood.

*National Certificates in Applied Physics.* The number of students taking the final examinations for Ordinary and Higher National Certificates in Applied Physics continues to increase. In 1957 542 students took the Ordinary certificate examination and 182 the Higher certificate examination (compared with 424 and 152 respectively in 1956). The Institute's assessors were Professor J. D. Craggs, Mr. A. E. De Barr and Dr. J. Topping for England and Wales, and Dr. G. Morris for Scotland.

## Education

*Revision of Schedules of Qualifications exempting from Graduateship Examination.* A sub-committee of six members of the Membership and Examinations Committee was set up to revise the lists of qualifications recognized by the Board as satisfying, completely or partially, the membership regulations relating to knowledge of physics ; the lists have not been revised for about fifteen years except for occasional additions. The sub-committee is continuing its work.

*General Education Requirements—Student grade.* The Board accepted a recommendation of the Membership and Examinations Committee that students following courses in recognized institutions leading to qualifications recognized by the Institute should be eligible for admission to the Student grade irrespective of compliance with the Institute's regulations concerning general education. Students who did not comply would be

required to do so before being eligible to become Graduates.

*Recognition of College Diplomas.* Five colleges requested the recognition of diplomas awarded on full time or sandwich courses as satisfying the Institute's academic requirements for membership. The colleges were visited by representatives of the Institute and two of the diplomas were accepted. These were the awards of Sunderland Technical College and the Welsh College of Advanced Technology, Cardiff. The other three applications were rejected.

**Stimulation of Entry to the Profession**

Arising from a proposal made at the 1956 annual meeting of Branch and Group officers, the Membership and Examinations Committee appointed a sub-committee of five members to consider ways in which the Institute might endeavour to stimulate increased entry to the profession. The report of the sub-committee was submitted to and approved by the Board. Various proposals were put forward and steps are being taken to implement them. To give general guidance to this work a committee has been established, consisting of one representative of each Branch in this country. A sub-committee has also been set up to deal with the special problems in Scotland.

**Publications**

*The Journals.* The circulation both to members and non-members of the *Journal of Scientific Instruments* and the *British Journal of Applied Physics* continued to increase satisfactorily.

The advertisement revenue received from the *Journal of Scientific Instruments* was slightly better than the previous year, but unfortunately this was more than offset by a decline in the advertisement revenue received from the *British Journal of Applied Physics.* As this is now an important source of income, the Board hopes that all those members who are in a position to do so will encourage or continue to encourage the support of the advertisement columns of the Journals.

Table 3 shows the amount of material submitted and published during the year, compared with the previous year's figures. Of the 159 papers submitted to the *Journal of Scientific Instruments* during the year and the 121 to the *British Journal of Applied Physics*, 38 and 15 respectively were still under consideration at the end of the year. The Advisory Committees of both Journals were satisfied that the standard of them had been maintained and this is largely due to the considerable time given by Fellows and others to the refereeing of papers, the reviewing of books and assisting the Editor in other ways. The Board is glad of this opportunity to place on record its thanks for this work.

Table 3. *Contributions submitted and published*

| | *J.S.I.* | | *B.J.A.P.* | |
|---|---|---|---|---|
| | *1956* | 1957 | *1956* | 1957 |
| *Extent of Journal (text pages)* ... ... ... ... ... | *512* | 520 | *456* | 502 |
| *Original papers (numbers) :* | | | | |
| Submitted ... ... ... ... ... ... ... | *156* | 159 | *119* | 121 |
| Accepted ... ... ... ... ... ... ... | *96* | 104 | *60* | 85 |
| Published ... ... ... ... ... ... ... | *117* | 97 | *74* | 83 |
| *Special articles and conference reports published (numbers)* ... | *4* | 11 | *14* | 13 |
| *Laboratory and Workshop Notes (numbers) :* | | | | |
| Submitted ... ... ... ... ... ... | *96* | 97 | — | — |
| Accepted ... ... ... ... ... ... ... | *64* | 62 | — | — |
| Published ... ... ... ... ... ... ... | *75* | 65 | — | — |
| *New Instruments, Materials and Tools :* | | | | |
| Items published ... ... ... ... ... ... | *82* | 70 | — | — |
| *Notices of manufacturers' publications* ... ... ... ... | *53* | 89 | — | — |
| *Letters to the Editor published* ... ... ... ... ... | *24* | 18 | *21* | 17 |
| *Number of book reviews published* ... ... ... ... | *13* | 32 | *111* | 133 |
| *Extent of Supplement (text pages)* ... ... ... ... | — | — | *107* | 69 |

The sixth Supplement to the *British Journal of Applied Physics* was published in May and contained a selection of the papers presented in recent months to the Institute's Non-Destructive Testing Group including most of those read at the Group's conference held in Bristol in July, 1956. Besides its value to members, it is hoped that this Supplement will assist engineers, metallurgists and

others to appreciate the importance of the new methods which are resulting from applications of physics to this field and to give them an opportunity of considering how far further suggestions for utilizing the physical behaviour of substances under various conditions can be used and developed as methods for non-destructive testing.

*Books.* During the year Mr. J. H. Leck's *Pressure Measurement in Vacuum Systems* was published by the Institute in its *Physics in Industry* series and also a revised edition of Dr. J. Topping's *Errors of Observation and Their Treatment* in the *Monographs for Students* series. Edward Arnold (Publishers) Ltd. published two books for the Institute : *A Further Handbook of Industrial Radiology* written by fifteen members of the Non-Destructive Testing Group and edited by Mr. W. J. Wiltshire, and *Laboratory and Workshop Notes 1953-55* (being a fourth selection reprinted from the *Journal of Scientific Instruments*) which was again compiled and edited by Dr. Ruth Lang. The Royalties from both these volumes are paid to the Institute's Benevolent Fund, and the Board wishes to record here its thanks to all concerned for these contributions.

In 1955 the Board reviewed its policy regarding the publication of books and decided " that after fulfilment of its present commitments for publishing books, only those likely to be of special importance to members or likely to advance the teaching of physics should be produced and published by the Institute and then only if they are unlikely to be published by a commercial house." During the year formal negotiations were opened with Messrs. Chapman & Hall Ltd. and an agreement with that firm became effective on December 1. This provides that future volumes in the *Physics in Industry* series and the *Monographs for Students* series will be published by that firm on behalf of the Institute. The stock of books in these two series has been sold to that firm (see paragraph on Finance below), but the Institute will continue to distribute copies of the old and new books to members at the privileged rates. The agreement also covers other books such as conference proceedings. The selection of titles and authors and the approval of manuscripts will remain the responsibility of the Institute. An Advisory Editorial Board has been appointed to discharge these responsibilities on behalf of the Board. Books previously published for the Institute by Messrs. Edward Arnold (Publishers) Ltd. will, of course, continue to be sold by that firm as will future editions of these books.

*Bulletin.* The Board agreed that copies of the *Bulletin* should be made available for display in the libraries of universities, recognized technical colleges and grammar schools of which members of the Institute are staff members.

The twelve monthly-issues consisted of 404 + lxxvi pages (344 + xcvi in 1956). Nineteen articles were published together with accounts of Branch and Group activities, lists of new elections and summaries of the principal contents of the Institute's two scientific journals. Reviews of sixty-six books were published and a total of 382 advertisements for physicists and technicians, etc., were included (compared with 439 in 1956 and 403 in 1955).

*Pamphlets.* A third edition of *The Scientific Education of Physicists*, which includes details of each university physics department and the physics courses of recognized technical colleges, was issued during the year. More than a thousand copies of this publication are distributed annually.

The proceedings of the conference on Degree and Diploma courses in Applied Physics, held in November, 1956, first published in four issues of the *Bulletin* were republished as a booklet with the title *The Education of Physicists in Universities and Colleges of Technology.*

## Convention, Conferences and Symposia

*Branch and Group Conferences and Symposia.* The Branches and Groups again held a number of small conferences and symposia and these are mentioned in that section of this Report.

*Third Institute Convention.* About 250 members, ladies and guests, attended the Institute's third Convention which was held at Oxford from July 10-13. The attendance was much smaller than had been expected but the meetings and social functions were highly successful and thoroughly enjoyed by all who attended. On this occasion no Group meetings were arranged, all the lectures being addressed to the Convention as a whole. The principal scientific lectures were by Professor N. F. Mott on " Dislocations and the physics of materials " and Professor A. C. B. Lovell on " Recent advances in radio astronomy." On the evening of July 11 Sir Cyril Hinshelwood addressed the Convention in the Sheldonian Theatre on " Physics among the sciences " ; this address was published in the September issue of the *Bulletin.* On the last two days of the Convention five papers were read by authors suggested by the Institute's Group Committees. On July 12 a lecture on " Science and the Humanities " was given by Mr. Alan Bullock, and was published in the December issue of the *Bulletin.* The social events included a dinner in the Hall of

Christ Church ; on another evening separate dinner parties arranged by Group Committees for their members and ladies were held and these were followed by a Convention dance at the Randolph Hotel. A number of technical visits and local tours were also arranged.

**British Conference on Automation and Computation**

The Board accepted an invitation of the three major engineering institutions to send representatives to exploratory conferences in March and April to consider closer collaboration of organizations interested in automation and computation. As a result, the "British Conference on Automation and Computation" was set up with the following three groups :

Group A—The engineering applications of automation techniques ;

Group B—The development and applications of computers, automatic controls and programming techniques ;

Group C—The sociological and economic aspects of automation and computation procedures.

The Institute is one of the five sponsoring societies of Group B, to which twenty-three societies now belong; it has now been named "The British Group for Computation and Automatic Control of the British Conference on Automation and Computation." The objects of the Group are :

(*a*) To foster the development and applications of automatic controls, computing and data processing equipment and programming techniques.

(*b*) To afford a common meeting ground for the adhering organizations whereby such of their activities as fall within the purview of the Group can, if so desired, be co-ordinated and extended.

(*c*) To maintain, as may be desirable, liaison with other Groups of the British Conference on Automation and Computation by direct contact and by representation on the General Committee of the British Conference.

(*d*) To encourage and, if desired, to co-ordinate the presentation at International Conferences of British papers whose subjects fall within the purview of the Group.

(*e*) Through the General Committee of the British Conference on Automation and Computation, to maintain, as may be desirable, liaison with corresponding National Committees of other countries which support such International Conferences.

The Institute has two representatives on the General Committee of the Group and is one of the six bodies represented at the Executive Committee. The Group has three representatives on the main Committee of the Conference which will arrange for liaison between the three Groups.

**Professional Matters**

*Inquiries.* The Permanent Officers, often advised by the Honorary Officers or other Fellows of the Institute with special knowledge, have as usual dealt with a number of confidential inquiries concerning professional matters. These were similar to those of previous years, including particularly inquiries about terms of contracts of service, suitability of salaries for various posts, availability of courses at all levels and prospects for physicists at home and oversea. An unusual inquiry concerned the teaching of physics to a man in one of H.M. prisons.

*Salary Survey.* The results of the fourth survey of salaries and emoluments of Fellows, Associates and Graduates were published in the January issue of the *Bulletin* and reprints were widely distributed. Many requests for copies of these data were received.

*Demand for Physicists.* Requests for assistance in filling vacancies for physicists continued to be received and inquirers were again advised to advertise these in the *Bulletin*, which has now become a recognized medium for this purpose.

The Board was again invited by the Scientific Manpower Committee of the Government's Advisory Council on Scientific Policy to assist it by providing data regarding the Institute's membership and by commenting on the supply and demand position. It again informed the Committee that "although the Board still has no good statistical information on which to base a reply, there is still general agreement among members of the Board that if the number of graduates in physics were doubled within five to ten years, the demand could still exceed the supply." In answer to a question about emigration the Board stated that "while the Institute has no quantitative data about the emigration of its members, the Board is perturbed by the number of first-class physicists who are leaving this country for permanent employment abroad."

**The Physical Society**

On the initiative of the Council of the Society, the Board commenced consideration of proposals for closer collaboration.

**Staff**

A presentation was made by the Board to the Secretary as a mark of recognition of his services to the Institute, on completion of twenty-five years as Secretary and Editor.

In order to deal effectively with the expanding work, two new senior posts on the staff were created and filled during the year. The Finance Assistant, Mr. E. A. Larwood, will supervise the Institute's business affairs, and the Education Assistant, Miss J. B. M. Bowers, will be responsible for some of the rapidly growing routine work arising from the Institute's Graduateship Examination and the National Certificate examinations and, in addition, will help to develop the Institute's other educational work, particularly that involving contacts with universities, technical colleges, schools and industry.

**The Institute's House**

*New lease.* During the year the protracted and complex negotiations between the Institute, the Grosvenor Estate (the ground landlords) and the Estate of Lord Mount Edgcumbe (the Institute's Landlord) for a new lease were completed.

*Repairs and decorations.* The front elevation of the House was painted and a few of the offices were redecorated during the year in addition to essential repairs and normal maintenance work.

*Gift.* The Board records with gratitude the gift of a $2 \times 2$ in. slide projector by the Research Laboratory of Kodak Ltd.

*Meetings.* The number of Institute meetings held in the House during the year is shown in Table 4.

Table 4. *Meetings held in the House*

| | *1956* | *1957* |
|---|---|---|
| Board and Committee meetings (including Branch and Group Committees) ... ... ... | *59* | 75 |
| Conference and Lecture meetings | *30* | 28 |
| Social functions ... ... ... | *5* | 14 |

**Acknowledgments**

*Branch, Group and Conference Officers.* The Board wishes to record its thanks to those members who have acted as Honorary Officers of the Institute's Branches, Groups and Conferences and who have thereby contributed greatly to the Institute's activities.

*Meeting Rooms and Visits.* The Board records its thanks to the many bodies which have generously allowed meetings of the Institute and of its Branches and Groups to be held on their premises or which have allowed visits to their laboratories or works.

**Finance**

The accounts are presented in the usual form with the same proportional allocation between them of the costs of running the House and the offices, as has been used since 1952. The final deficit for the year on the combined accounts (Institute and Endowment Trust Fund) is £2964.

At the request of the Board the investment portfolio was critically examined by the Institute's brokers and other financial experts and, as a result, some of the investments held by the Institute, the Endowment Trust Fund and the Benevolent Fund were sold and re-invested in April.

*The Institute of Physics Accounts.* The rising costs, growing activities of the Institute and of its membership, are reflected throughout these accounts. Following the normal practice, funds have been transferred from this account to the Endowment Trust Fund Account, so that members' subscriptions contribute towards the cost of educational and scientific work borne almost entirely by the Trust Fund. The amount for the year was £3,400.

*Endowment Trust Fund Accounts.* The publications business, which forms the major part of these accounts, shows a surplus of £5,750 which is a welcome and necessary support for the work of the Endowment Trust Fund. As the stock of books has been sold to a commercial publisher (see above), the £2,000 reserve for stock depreciation has been written back into the Fund.

**Benevolent Fund**

Fortunately the calls on the Fund have again been readily met from current income ; but the Fund Committee is still anxious to build up a substantial capital sum to enable it to give adequate help should circumstances arise that may cause many more members or their dependants to require help. It is therefore particularly grateful to those who subscribe to the Fund and to those who have provided the books from which royalties are received.

The Fund assisted two new cases and gave further help to three old ones compared with four and five respectively the previous year.

The Fund Committee wishes to take this opportunity of recording its thanks to those members who have investigated cases on its behalf or acted as Trustees of money provided from the Fund.

## Branches and Groups

*Annual meeting of Branch and Group Officers.* The fourteenth annual consultative meeting of the Honorary Officers of Branches and Groups was held in Oxford just prior to the opening of the Convention on July 10. The Honorary Secretary opened a discussion on the future basis upon which Groups should be organized and controlled and, as a result of the recommendation made to the Board, a Meetings Committee has been set up with power to co-opt a member closely connected with the organization of meetings of The Physical Society. Other items considered were the services provided by headquarters, the *Bulletin* and the possibility of occasionally holding the Annual General Meeting outside London.

*The Branch and Group Officers named below were as at December 31, 1957.*

**Australian Branch :** *President :* Dr. F. W. G. White. *Vice-President :* Professor H. C. Webster. *Honorary Treasurer :* Dr. J. S. Rogers. *Honorary Secretary :* Dr. J. K. Mackenzie. (457 members.)

The Branch suffered a great loss during the year by the death of Dr. J. C. Bower who was at the time Branch Honorary Secretary.

The Divisions of the Branch in the different States have again held many meetings, three of which were addressed by Dr. W. H. Taylor, one of the Institute's Vice-Presidents. The New South Wales Division formed a "Solid State Physics" Group — the first specialist group to be formed within the Branch.

The fifth Exhibition of scientific instruments and apparatus arranged by the Victoria Division was held in Melbourne in March and was opened by the Hon. Howard Beale, Minister for Supply and Minister for Defence Production. As usual a handbook was issued describing the exhibits, contributed by forty private firms and eight government departments. It is estimated that about 3,000 persons visited the Exhibition during the three days it was open.

The Branch is represented on various National Committees, and, as a result of its representations, the Australian Academy of Science has agreed to form a National Committee on Optics so that Australia can become affiliated with the C.I.O.

**Malayan Branch.** *Chairman :* Mr. Hon Yung Sen. *Honorary Secretary and Treasurer :* Mrs. D. J. Rankin. (30 members.)

The meetings held during the year included a demonstration of high-quality musical reproduction by The General Electric Co. (Malaya) Ltd. in Singapore.

**Liverpool and North Wales Branch.** *Chairman :* Professor E. A. Owen. *Honorary Secretary :* Mr. A. Ashmore. (182 members.)

Six lectures were held in Liverpool, one in Bangor and one in Wrexham. In addition, a one-day discussion on "The shortage of physicists" was held in Liverpool.

**London and Home Counties Branch.** *Chairman :* Dr. J. S. Forrest. *Honorary Secretary :* Mr. D. T. R. Dighton. (2,415 members.)

Five lectures were held in the Institute's House. Visits were arranged to the laboratories of the Morgan Crucible Co. Ltd., London, the Physics and Light Divisions of the National Physical Laboratory and to the Ford Motor Co. Ltd., at Dagenham. A symposium on "The design of physics research laboratories" was held at the Royal Institution on November 27 ; summaries of this important meeting have already been published and it is hoped that the full proceedings will appear early in 1958.

**Manchester and District Branch.** *Chairman :* Dr. R. W. Sillars. *Honorary Secretary :* Dr. J. E. Geake. (428 members.)

Six lectures were held in Manchester and a summer visit was paid to the Research Department of Metropolitan-Vickers Electrical Co. Ltd. The Branch annual dinner was held in March and a conversazione marking the 25th anniversary of the formation of the Branch was held on October 23 in the Engineers' Club, Manchester, and was attended by the President and other distinguished visitors.

Children's Christmas lectures were delivered on two days in January.

**Midland Branch.** *Chairman :* Dr. R. E. Bastick. *Honorary Secretary :* Dr. R. J. Wakelin. (600 members.)

Five lectures were held in Birmingham. Visits followed by talks were arranged to Triplex Safety Glass, King's Norton, and to the Coal Research Establishment, Stoke Orchard.

The Branch annual dinner was held in April.

**North Eastern Branch.** *Chairman :* Dr. O. P. T. Kantorowicz. *Honorary Secretary :* Dr. W. D. Corner. (146 members.)

Four lectures were held in Newcastle, two in Durham and one in Sunderland. A two-day discussion in association with the Acoustics Group of The Physical Society was held at Pametrada Research Station and the University of Durham, King's College, Newcastle-upon-Tyne.

**Scottish Branch.** *Chairman :* Mr. R. M. Sillitto. *Honorary Secretary :* Dr. A. R. Boyle. (280 members.)

Twelve lectures were held in Glasgow, nine in Edinburgh, one in Aberdeen, two in Dundee and one in St. Andrews. In addition, in conjunction with the Education Group, a two-day conference was held entitled " A Scottish conference on training in physics."

**South Wales Branch.** *Chairman :* Professor R. M. Davies. *Honorary Secretary :* Dr. H. O. Puls. (209 members.)

Two lectures were held in Swansea, three in Cardiff and one in Aberystwyth.

**South Western Branch.** *Chairman :* Professor S. H. Piper. *Honorary Secretary :* Dr. S. H. Ayliffe. (220 members.)

The inaugural meeting of the Branch was held on May 13 at the H. H. Wills Physical Laboratories, Bristol, at which an address was given by Professor H. S. W. Massey. Two other lectures were given in Bristol and a visit was made to the Royal Military College of Science, Shrivenham, where a talk was given by Professor F. A. Vick, Honorary Secretary of the Institute on " The field emission of electrons."

**Yorkshire Branch.** *Chairman :* Professor W. Sucksmith. *Honorary Secretary :* Dr. M. McCaig. (240 members.)

Two lectures were held in Leeds and two in Sheffield. The summer meeting took the form of a combined visit to the United Steel Companies Ltd., Rotherham ; Walker and Hall Ltd., Sheffield, and the Brown-Firth Research Laboratories, Sheffield. A joint two-day conference with the Non-Destructive Testing Group was held in Sheffield.

**Applied Spectroscopy Group.** *Chairman :* Dr. A. C. G. Menzies. *Honorary Secretary :* Mr. F. W. J. Garton. (190 members.)

A joint meeting with the Education Group on " The education and training of spectroscopists " was held in London. An all-day meeting on " Spectroscopy in the United Kingdom Atomic Energy Authority " was held at the Institute's House.

In view of increasingly widening interests of members it was decided at the Annual General Meeting on November 15 to change the title of the Group from the " Industrial Spectroscopy Group " to the " Applied Spectroscopy Group." This was approved by the Board of the Institute and became effective from the Annual General Meeting.

**Education Group.** *Chairman :* Mr. G. W. Warren. *Honorary Secretary :* Mr. T. H. Tyler. (312 members.)

Five lectures were held at the Institute's House in addition to a joint meeting with the Applied Spectroscopy Group (reported above). The summer meeting took the form of a visit to the College of Aeronautics, Cranfield. A joint meeting with the Scottish Branch was held in Glasgow (reported above).

**Electronics Group.** *Chairman :* Dr. M. E. Haine. *Honorary Secretary :* Mr. S. Rodda. (409 members.)

Six lectures were held at the Institute's House and a two-day autumn conference on Transistors was held at the Brunel College of Technology, London.

**Electron Microscopy Group.** *Chairman :* Dr. J. W. Menter. *Honorary Secretary :* Mr. H. W. Emerton. (282 members.)

The annual three-day conference was held at the University College of North Wales, Bangor, in September.

**Non-Destructive Testing Group.** *Chairman:* Dr. J. Thewlis. *Honorary Secretary :* Mr. R. S. Sharpe. (317 members.)

Eight lectures were held in the Institute's House and a two-day conference which was arranged jointly with the Yorkshire Branch was held in Sheffield at which the main subjects were " Magnetism " and " Grain boundary problems in metal."

Acting through the Group, the Institute has become a member of the British National Committee for Non-Destructive Testing (see below), and is represented on the Committee by the Chairman of the Group.

**Stress Analysis Group.** *Chairman :* Mr. B. Sugarman. *Honorary Secretary :* Mr. V. M. Hickson. (173 members.)

The Group's annual three-day conference was held at University College, Leicester. A discussion was held on " Photoelastic reflection technique " at University College, London, and a visit was made to the Aeronautical Inspection Directorate Laboratories at Harefield.

**X-ray Analysis Group.** *Chairman :* Professor E. G. Cox. *Honorary Secretary :* Dr. R. L. Gordon. (316 members.)

The two-day spring conference on " Minerals and inorganic compounds " was held at University College, Cardiff, and a lecture meeting in the autumn was held at the Institute's House.

The Group's Equipment Sub-Committee has continued its work on materials and equipment

for X-ray crystallography. In the field of collection of crystallographic data, preparation of a tingle crystal index has continued at the University of Leeds and at the National Institute for Medical Research, Mill Hill ; and the work at University College, Cardiff, on data for the A.S.T.M. powder data file has been supplemented by a one-year grant to the University of Sheffield for studies of intermetallic compounds of manganese which will provide contributions to the file.

**Extracts from Reports to the Board of Representatives and Nominees on Joint Committees and other Bodies**

*Parliamentary and Scientific Committee.* During the year the General Committee met seven times, when discussions, opened by leading authorities, were held; these covered a wide range of scientific and technical matters now prominently before the public. A large number of the Parliamentary members of the Committee took part in the debate on "Technological education and scientific manpower" in the House of Commons on March 22. A sub-committee has been appointed to keep the main Committee informed on current problems connected with this important subject. The "somewhat haphazard" operation of the Scientific Societies Act in connection with the rating of the premises of several of the constituent bodies has received close attention during the year and the Minister has asked his Committee considering the rating of charities and similar organizations, to consider the special position of Scientific Societies and Institutions and Research Associations.

*The Royal Society's National Committee for Physics.* The Committee appointed delegates to the General Assembly of the International Union of Pure and Applied Physics in Rome in September, and prepared instructions for them. Consideration was given to the size, expense, circulation and speed of publication of reports of international conferences, and these matters are to be studied further.

*The Royal Society's National Committee for Crystallography.* The Committee met twice and considered preparations for the fourth and fifth General Assemblies of the International Union of Crystallography, the former held in Montreal in July and the latter to be held in Cambridge in 1960. In addition, general matters of interest to crystallographers were considered, including, for example, problems arising in the teaching of crystallography.

*British National Committee for Non-Destructive Testing.* The Committee has considered ways in which co-operation between the various bodies in the country interested in non-destructive testing can be furthered. At the recent International Conference in Chicago it was represented by three delegates (of which Dr. Thewlis, the Institute's representative, was one) and it also co-ordinated the rest of the British party. It is arranging for a Summer School in non-destructive testing to be held at the Manchester College of Technology in 1958. Encouraged by the response from member bodies (among which are included all the major professional institutions concerned with the subject) the Committee has extended an invitation to the International Non-Destructive Testing Committee to hold the fourth International Conference in Great Britain in 1963. The third International Conference is to be held in Japan in 1960.

*The British Group for Computation and Automatic Control of the British Conference on Automation and Computation.* This Group, referred to above, formally came into being in December when its constitution was approved by the General Committee. Several informal meetings had previously been held to discuss the kind of activity that could usefully be undertaken.

*The Royal Society's Paul Instrument Fund Committee.* The Committee met twice during 1957 and also transacted quite a large amount of business by correspondence. Grants totalling £9,175 were paid for projects previously authorized and grants for new researches or extension of previous work were authorized amounting to £9,775. The meniscus Schmidt camera for use in photographing meteors for which a total grant of over £20,000 was made has been completed. It is being used by the Jodrell Bank Experimental Station and is working most satisfactorily. Other projects supported by the Fund and completed during the year are the measurement of power in an electromagnetic field by the application of the Hall effect in a semi-conductor ; construction of a large proportional counter for radiocarbon assay ; an integrating mechanism for a Weissenberg goniometer; a multichannel spectrometer for possible use with faint radiation sources in the infra-red ; a Cherenkov radiation gamma spectrometer.

*Board of the British Nuclear Energy Conference.* The Board met four times to consider regular business, including the production of the Conference's quarterly journal and the exchange of information about papers on nuclear energy submitted to the constituent bodies and the conferences and symposia arranged by them.

The Iron and Steel Institute, The Institute of

Metals and The Institute of Fuel were admitted as constituent bodies, and the applications of others are under consideration.

*Committee of Management of "Science Abstracts."* The Committee has held four meetings during the year. It has been concerned primarily with the most appropriate method of dealing with the rapidly increasing literature, particularly in those fields in which scientific and technical problems are difficult to separate.

*Ministry of Labour and National Service's Panel on Special Regulations for Protection against Ionizing Radiations.* Nine meetings were held during the year. A preliminary draft of regulations covering closed sources of ionizing radiations was completed by May and was circulated to interested parties for comment. During the second half of the year the Panel was engaged on a second set of regulations concerned with the use of open sources. It is hoped to complete this work in the first half of 1958.

*National Council for Technological Awards : Board of Studies in Technologies other than Engineering.* The National Council has had a busy year, and has issued its first report, for the period December, 1955, to July, 1957. The Applied Physics Panel reports to the Board of Studies in Technologies other than Engineering, and has made recommendations on a number of applications from Technical Colleges for recognition of courses in Applied Physics as leading to the Diploma in Technology. A list of courses recognized up to July, 1957, is contained in the Council's report. During the year the Council set up a special committee to make recommendations as to what postgraduate awards the Council should offer. The Council has also issued regulations on examinations and conditions for the award of the Diploma.

*London and Home Counties Regional Advisory Council for Higher Technological Education—Applied Physics Advisory Committee.* The Committee has continued to meet regularly and performs a useful function in advising the Council on the location of courses in physics and applied physics in the colleges in the area.

*Science Advisory Sub-Committee of the Regional Council for Further Education for the South-West.* The Committee is on the whole satisfied with the steady progress and expanding facilities for teaching science in the area, and local industry is increasing its co-operation in this work.

*Science Advisory Committee of Blackburn Municipal Technical College.* The Committee has considered plans for the new Science Department and the possibility of establishing courses for the National Certificate in Applied Physics and for the examination for Graduateship of The Institute of Physics.

*Governing Body of Brunel College of Technology.* The College was officially opened by the Minister of Education on September 30, 1957, and the Board of Governors has had two meetings and its Committees have also held several meetings to consider the many problems, including staffing, that confront a new College. Dr. C. A. Hogarth of the Royal Radar Establishment has been appointed Head of the Physics Department. Many sandwich courses, including that in applied physics, have already been recognized by the National Council for Technological Awards, and it is hoped that the College will eventually be recognized as one of Advanced Technology.

*Governing Body of Croydon Technical College.* The detailed planning of the laboratories in the new building is complete, and they should be in occupation by September. The equipment of the physics laboratories has been considerably extended in the past year.

*Science Advisory Committee of Croydon Technical College.* The Committee learnt with satisfaction that all classes in the Science Department had been well attended during the year. Teaching staff was adequate, but difficulty was experienced in obtaining laboratory technicians. New courses established during the year included one for the examination for Graduateship of The Institute of Physics.

*Science Advisory Committee of Ewell County Technical College.* The main subject under discussion during the year has been the National Certificate course in Applied Physics and other subjects, and in particular, the establishment of Higher National Certificate courses and whether they shall be held in Ewell County Technical College or in a neighbouring one.

*Science Advisory Committee of Luton and South Bedfordshire College of Further Education.* The Science Department held a successful Open Day in May, which enabled many visitors to inspect the new buildings now occupied by the Department ; the Committee contributed advice on several points during the preparations for this occasion. Three members of the staff of the College are now undertaking research work but as yet no research in physics has been started. The advice of the Committee was sought on the choice of books for the new library in the Science Department.

*Court of Governors of Manchester College of Science and Technology.* At the annual meeting of the

Court, the annual report on the working of the College and the financial statement were presented and accepted. Statements were also made by the President and by the Principal. The extensions to the College were opened by H.R.H. The Duke of Edinburgh on November 22.

*Governing Body of Norwood Technical College.* The Consultative Committee for Physics has now been formed and has representatives from the Governing Body, from industry and a trade association, from The Institute of Physics and a senior science master from one of the local secondary modern schools. Discussions have taken place on a proposal to institute a works-based sandwich course combining B.Sc.(General) and telecommunications, the College being well qualified in both fields.

*Science Advisory Sub-Committee of Poole College for Further Education.* Two meetings were held during the year at which reports on progress in the physics and chemistry courses were considered. Detailed estimates for apparatus for the year 1958/59, which included considerable expenditure for completing the equipment of the new laboratories, were considered. Both day and evening courses in physics and chemistry to G.C.E. (ordinary level) are in operation. These will be stepped up to advanced level as the requirements of engineering courses to Institution membership standard necessitates.

*Governing Body of Rutherford College of Technology, Newcastle-upon-Tyne.* Four meetings of the Governing Body have been held during the year. In June the Ministry of Education announced that the College had been selected for eventual up-grading to College of Advanced Technology status, and in their subsequent meetings the Governors have considered how the new status can be implemented, particularly with regard to the change in the building program which will be necessitated, and the development of full-time and sandwich courses which will have to be provided before the college can be designated a College of Advanced Technology.

The College and King's College (University of Durham), in association with the U.K. Atomic Energy Authority and the Kemsley Press, sponsored a highly successful exhibition in Newcastle-upon-Tyne entitled "Atom 1958" which was attended by large numbers of students, parties from local industry and the general public.

*Science Advisory Committee of Slough College of Further Education.* Enrolments for the Ordinary National Certificate course in applied physics were reported to be small and the course has therefore been correlated with the one at Harrow Technical College so that students could transfer for the third year. A course in laboratory techniquse distinct in its aims from the City and Guilds of London Institute's course has been started satisfactorily. Postgraduate evening lecture courses were discussed and a one-day course in gas-chromatography was arranged.

Generous funds were made available for the new library and there is a possibility that this may form the nucleus of a science library for the Slough area.

*Science Advisory Committee of Southend Municipal College.* This Committee was established during the year and so far has held one meeting. The college is running successful courses, with good numbers of students, for both the Ordinary and Higher National Certificates in Applied Physics and the facilities are being improved to comply with the requirements of the Institute.

*Governing Body of the Welsh College of Advanced Technology, Cardiff.* The Governing Body met three times and Dr. Puls, the Institute's representative, was appointed a member of the Academic Staffing Committee and Chairman of the Advisory Sub-Committee for Applied Physics. Recruitment to the College Associateship course in Applied Physics (provisionally recognized by the Board as exempting from the Graduateship Examination) is proving difficult.

### BRITISH STANDARDS INSTITUTION COMMITTEES

*Committee on Units and Symbols Standards.* British Standards coming in the field covered by this Committee which reached an advanced stage of preparation during the year included : (i) glossary of terms used in nuclear science, (ii) four new parts supplementing Part I (General) of B.S. 1991, *Letter symbols, signs and abbreviations*, viz. : (*a*) chemical engineering, nuclear and applied chemistry, (*b*) fluid mechanics, (*c*) structures, materials and soil mechanics, (*d*) heat engines.

The following Standards were published during 1957 : B.S. 2846, *The reduction and presentation of experimental results ;* B.S. 2856, *Precise conversion of inch and metric sizes on engineering drawings.* Standards which are being prepared by Sub-Committees and which are due for publication during the first half of 1958 are : Glossary of terms used in high vacuum technology and Conversion factors and tables (Part I of revision of B.S. 350).

*Sub-Committee on Glossary of Terms used in Nuclear Sciences.* The Committee continues to meet at regular monthly intervals to define further terms used in nuclear science. A new draft of all the terms defined so far has been issued. The work

is now nearing completion, and it is hoped that the glossary will be published next year.

*Technical Committee on Abbreviations and Letter Symbols.* The Committee, jointly with the Committee for "Co-ordination of definitions, units and technical data" considered at length the following documents submitted by the International Standards Organization: (*a*) some principles for printing symbols and numbers, (*b*) proposals for mathematical signs and symbols, (*c*) quantities and units of mechanics, (*d*) the heat section of tables of quantities and units.

The preparation of further parts of B.S. 1991 is reported above.

*Instrument Industry Standards Committee.* Among the subjects for new or revised British or International Standards considered by the Committee and its Sub-Committees during the year were terminology of process control, fluid flow measurement, instruments for flue gas analysis, pressure gauges, magnetic compasses for ships, speedometers, odometers and tachometers, graphical symbols for instruments, temperature measurement and testing procedure. Work was completed on some new British Standards coming within the purview of the Committee.

*Sub-Committee on Barytes for Plaster and Concrete.* A draft for British aggregates for concrete and plaster has been prepared and submitted to the Fine and Heavy Chemical Industries Standards Committee.

*Code Drafting Committee on the Use of Electronic Valves.* This Committee continued work on the draft of Part IV of the Code of Practice. It contains Section 9, magnetrons, and Section 10, special quality valves. The final draft was passed to Council committees for approval and publication in November.

*Panel on Pocket Ionization Chambers and Dosemeters.* At the first meeting of this Panel it was suggested that it would be in the interests of both manufacturers and users if British Standards for pocket dosemeters and for pocket ionization chambers were prepared.

*Technical Committee on Radiographic Examination of Welded Joints.* The draft standard circulated to industry for comment has been revised by the Committee and Sub-Committee in accordance with the comments received and is now published as B.S. 2910, 1957, *General recommendations for the radiographic examination of fusion welded circumferential butt joints in steel pipes.*

*Technical Committee on Glossary of Rubber Terms.* The subjects discussed at the seven meetings held during the year were primarily those of terms used in the industry, particularly the manufacturing processes.

O. W. HUMPHREYS,
*President.*

J. TAYLOR,
*Honorary Treasurer.*

H. R. LANG,
*Secretary.*

F. A. VICK,
*Honorary Secretary.*

# THE INSTITUTE OF PHYSICS

## INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST DECEMBER, 1957

| 1956 £ | | £ | 1956 £ | | £ |
|---|---|---|---|---|---|
| | To Office and general expenses :— | | 14,033 | By Members' subscriptions, entrance and other fees | 15,013 |
| 3,792 | Salaries and National Insurance ... ... | 4,566 | 88 | „ Dividends and interest less tax ... ... ... | 74 |
| 173 | Staff superannuation ... ... ... ... | 235 | | „ Contribution from Endowment Trust Fund for alterations of premises, depreciation of furniture, fittings, office machinery and leasehold redemption policy :— | |
| 1,331 | Rent, rates, heating, cleaning, maintenance, etc. ... ... ... ... ... ... | 1,570 | 1,284 | Charged to cost of publications ... 1,289 | |
| 778 | Board, Committees' and Officers' travelling expenses ... ... ... ... ... | 1,311 | 642 | Charged to other work ... ... 645 | 1,934 |
| 588 | Printing and stationery... ... ... ... | 599 | | | |
| 1,527 | Bulletin ... ... ... ... ... ... | 1,806 | | | |
| 544 | Postage and telephones... ... ... ... | 613 | | | |
| 311 | Miscellaneous expenses ... ... ... | 297 | | | |
| 9,044 | | 10,997 | | | |
| 1,205 | „ Depreciation of furniture, fittings and office machinery ... ... ... ... ... | 1,215 | | | |
| 378 | „ Amount written off expenditure on alterations, improvements and adaptation to House ... | 378 | | | |
| 985 | „ Leasehold Redemption Policy ... ... ... | 985 | | | |
| 3,500 | „ Grant to Endowment Trust Fund ... ... | 3,400 | | | |
| 935 | „ Balance, being excess of income over expenditure carried to Reserve Fund ... ... ... | 46 | | | |
| £16,047 | | £17,021 | £16,047 | | £17,021 |

# THE INSTITUTE OF PHYSICS

## BALANCE SHEET, 31ST DECEMBER, 1957

| 1956 | | £ | £ |
|---|---|---|---|
| £ | | | |
| | LIFE MEMBERSHIP FUND :— | | |
| | As at 31st December, 1956... ... ... | 4,832 | |
| 4,832 | *Less :* Transfer to Reserve Fund in respect of deceased members ... ... | 58 | 4,774 |
| | RESERVE FUND :— | | |
| 17,433 | As at 31st December, 1956... ... ... | 19,427 | |
| 74 | *Add :* Transfer from Life Membership Fund | 58 | |
| 985 | Sinking Fund Leasehold Property ... | 985 | |
| 1,770 | Mrs. Phillips' Bequest ... ... | 1,770 | |
| | Income and Expenditure Account— | | |
| 935 | Balance ... ... ... ... | 46 | |
| | | 22,286 | |
| | *Less :* Loss on sale of investments ... ... | 45 | 22,241 |
| | CURRENT LIABILITIES :— | | |
| | Payments received from members in advance | 428 | |
| 3,387 | For Expenses ... ... ... ... | 1,645 | 2,073 |
| £29,416 | | | £29,088 |

O. W. HUMPHREYS, *President.*
J. TAYLOR, *Honorary Treasurer.*

| 1956 | | Cost to 31/12/56 | Additions during year | Depreciation to 31/12/56 | Depreciation during year | |
|---|---|---|---|---|---|---|
| £ | | £ | £ | £ | £ | £ |
| | FIXED ASSETS :— | | | | | |
| 1,310 | FURNITURE, FITTINGS AND OFFICE EQUIPMENT ... | 6,023 | 815 | 4,713 | 1,215 | 910 |
| 6,137 | ALTERATIONS, IMPROVEMENTS AND ADAPTATION OF PREMISES ... | 10,289 | — | 4,152 | 378 | 5,759 |
| 7,447 | | | | | | 6,669 |
| | CURRENT ASSETS :— | | | | | |
| 562 | STOCK ON HAND—STATIONERY ... ... | | | | | 552 |
| 1,226 | DEBTORS—SUNDRY ACCOUNTS ... ... | | | | | 620 |
| 7,441 | DUE FROM ENDOWMENT TRUST FUND ... | | | | | 7,287 |
| 29 | SUBSCRIPTIONS IN ARREARS ... ... | | | | | 34 |
| | INVESTMENTS :— | | | | | |
| 4,980 | Quoted ... ... ... ... ... | | | | 4,932 | |
| 500 | Unquoted ... ... ... ... | | | | 500 | 5,432 |
| | (*Estimated market value on 31st December, 1957, £4,674*) | | | | | |
| 6,895 | LEASEHOLD REDEMPTION POLICY ... ... | | | | | 7,880 |
| 336 | BANK BALANCE AND CASH IN HAND ... | | | | | 614 |
| £29,416 | | | | | | £29,088 |

*Report of the Auditors to The Members of The Institute of Physics*

We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purposes of our audit. In our opinion proper books of account have been kept by the Institute so far as appears from our examination of those books, and proper returns adequate for the purposes of our audit have been received from Branches of the Institute not visited by us. We have examined the above Balance Sheet and annexed Income and Expenditure Account which are in agreement with the books of the Institute. In our opinion and to the best of our information and according to the explanations given to us the said accounts give the information required by the Companies Act, 1948, in the manner so required and the Balance Sheet gives a true and fair view of the state of the Institute's affairs as at 31st December, 1957, and the Income and Expenditure Account gives a true and fair view of the excess of expenditure over income for the year ended on that date.

Spencer House, South Place, London, E.C.2.
*10th February, 1958*

KNOX, CROPPER & CO., *Chartered Accountants.*

# THE INSTITUTE OF PHYSICS—ENDOWMENT TRUST FUND

## INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1957

| 1956 | | £ |
|---|---|---|
| £ | | |
| | To Graduates and National Certificates Examinations | 981 |
| 749 | | |
| 2,499 | „ Expenses of Branches and Groups | 2,702 |
| 1,293 | „ Conference expenses | 1,156 |
| 273 | „ Educational booklets and reports | 690 |
| | „ Cost of production and distribution of publications sold | 40,395 |
| 36,065 | | |
| | „ Proportion of overhead charges in connection with the work carried on by the Trust | 8,072 |
| 6,777 | | |
| | „ Contribution to cost of repairs and alterations of House, depreciation of furniture and Leasehold Redemption Fund | 645 |
| 642 | | |
| 395 | „ Balance, carried to Trust Fund | — |
| £48,693 | | £54,641 |

| 1956 | | £ |
|---|---|---|
| £ | | |
| 788 | By Fees for examinations | 1,132 |
| 157 | „ Donations | 157 |
| 552 | „ Interest | 566 |
| | „ Receipts from publications, including advertisements | 46,145 |
| 41,708 | | |
| 3,500 | „ Grant from The Institute of Physics | 3,400 |
| 1,212 | „ Receipts for conferences | — |
| 776 | „ Non-members' conference fees | 231 |
| — | „ Balance, being deficit carried to Trust Fund | 3,010 |
| £48,693 | | £54,641 |

## BALANCE SHEET, 31st DECEMBER, 1957

| 1956 | | £ | £ |
|---|---|---|---|
| £ | | | |
| | ENDOWMENT TRUST FUND :— | | |
| | As at 31st December, 1956 | 345 | |
| | *Add :* Reserve for book stock depreciation | 2,000 | |
| | | 2,345 | |
| | *Less :* Loss on sale of investments | 136 | |
| | Income and Expenditure Account —Balance | 3,010 | |
| 345 | Debit Balance per contra | £ 801 | |
| 2,000 | RESERVE FOR BOOK STOCK DEPRECIATION | | — |
| | CURRENT LIABILITIES :— | | |
| 16,960 | X-ray Index Fund | 19,743 | |
| 8,965 | Publications, subscriptions in advance | 10,101 | |
| 2,972 | Printing and publishing expenses | 4,198 | |
| 7,441 | Due to The Institute of Physics | 7,287 | 41,329 |
| £38,683 | | | £41,329 |

O. W. HUMPHREYS, *President.*
J. TAYLOR, *Honorary Treasurer.*

| 1956 | | £ | £ |
|---|---|---|---|
| £ | | | |
| | INVESTMENTS :— | | |
| 6,799 | Quoted | 15,657 | |
| — | Unquoted | 10,000 | 25,657 |
| | (*Estimated market value on 31st December, 1957, £24,199*) | | |
| 3,333 | SAVINGS BANK DEPOSITS | | 201 |
| 4,338 | STOCK ON HAND—Publications and dispatch material | | 1,942 |
| 5,614 | SUNDRY DEBTORS, PUBLICATIONS, ETC. | | 6,095 |
| 18,599 | BANK BALANCES AND CASH IN HAND | | 6,633 |
| — | ENDOWMENT TRUST FUND—Balance per contra | | 801 |
| £38,683 | | | £41,329 |

We have audited the above Balance Sheet and have obtained all the information and explanations we have required. We have verified the Bank Balances and the Investments. In our opinion such Balance Sheet is properly drawn up so as to exhibit a true and correct view of the state of the Fund according to the best of our information and the explanations given to us and as shown by the books of the Fund.

Spencer House, South Place, London, E.C.2.
*10th February, 1958*

KNOX, CROPPER & CO., *Chartered Accountants.*

# THE INSTITUTE OF PHYSICS—BENEVOLENT FUND

## INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST DECEMBER, 1957

| 1956 | | | 1956 | | |
|---|---|---|---|---|---|
| £ | | £ | £ | | £ |
| 614 | To Grants ... ... ... ... ... ... | 506 | 1,252 | By Subscriptions and donations ... ... ... | 1,302 |
| 891 | „ Balance, being excess of income over expenditure carried to Capital Account ... ... ... | 1,051 | 148 | „ Interest ... ... ... ... ... ... | 172 |
| | | | 105 | „ Royalties on books ... ... ... ... | 83 |
| £1,505 | | £1,557 | £1,505 | | £1,557 |

## BALANCE SHEET 31ST DECEMBER, 1957

| 1956 | | | | 1956 | | |
|---|---|---|---|---|---|---|
| £ | | £ | £ | £ | | £ |
| | CAPITAL ACCOUNT :— | | | 2,633 | GOVERNMENT SECURITIES, at cost ... ... ... (*Estimated market value at 31st December, 1957, £1,979*) | 2,542 |
| | On 31st December, 1956 ... ... ... | 6,115 | | 27 | DEBTORS ... ... ... ... ... ... | 18 |
| | *Add :* Transfer from Income and Expenditure Account ... ... ... | 1,051 | | 2,752 | CASH ON DEPOSIT AT POST OFFICE SAVINGS BANK ... | — |
| | | 7,166 | | 703 | CASH AT BANK—Current Account ... ... ... | 493 |
| 6,115 | *Less :* Loss on sale of investments ... | 91 | 7,075 | — | Deposit Account ... ... ... | 4,022 |
| | J. TAYLOR, *Chairman of Fund Committee.* | | | | | |
| | H. R. LANG, *Secretary of the Committee.* | | | | | |
| £6,115 | | | £7,075 | £6,115 | | £7,075 |

We have audited the above Balance Sheet and have obtained all the information and explanations we have required. We have verified the Bank Balances and the Investments. In our opinion such Balance Sheet is properly drawn up so as to exhibit a true and correct view of the state of the Fund according to the best of our information and the explanations given to us and as shown by the books of the Fund.

Spencer House, South Place, London, E.C.2.
*10th February, 1958*

KNOX, CROPPER & CO., *Chartered Accountants.*

## Insurances for Physicists

☐ **RETIREMENT PENSIONS** with full Tax Relief (1956 Finance Act)

☐ **ENDOWMENT ASSURANCE.** An adaptable policy suitable for Investment, House Purchase or a Tax-free capital sum on retirement.

☐ **NON-CANCELLABLE SICKNESS AND ACCIDENT INSURANCE,** providing an income during disablement up to age 65.

☐ **HOUSEHOLDERS COMPREHENSIVE INSURANCE** on Buildings and/or Contents, with No Claims Bonus.

☐ **MOTOR INSURANCE.** Special Scheme with immediate 33⅓% No Claims Bonus.

Name..... Date of Birth.....
(BLOCK LETTERS PLEASE)

Address .....

These policies are of particular interest to physicists.

For further details please complete this form and send to :

**WALTER HERRIOT & CO. LTD.**
*Incorporated Insurance Brokers*
**Broad Street House, 54 Old Broad Street, London, E.C.2**
(Telephone : LONdon Wall 7007/8)


MONSANTO CHEMICALS LTD.

are expanding their operations in the plastics field and require young graduates in physics, applied physics, mechanical and chemical engineering, for the research laboratories at Newport, Monmouthshire. The physicists are needed for work involving both theoretical and practical studies over a wide field of plastics.

The mechanical and chemical engineers are required for the development and larger scale practical application of results obtained in the laboratories. Full details of age, education, training and experience to be sent to D.L.2, Personnel Department, Monsanto Chemicals Ltd., Monsanto House, 10-18 Victoria Street, S.W.1.

TECHNICAL
SALES REPRESENTATIVE

A vacancy occurs for a young man aged 20-30 to be trained as a technical sales representative.

Applicants must have a science degree (B.Sc.) or similar qualification.

Full particulars and application form may be obtained from Mr. R. O. Allston, The Ever Ready Co. (G.B.) Ltd., Hercules Place, Holloway, N.7.

MIDDLESEX COUNTY COUNCIL
Education Committee
BRUNEL COLLEGE OF TECHNOLOGY,
WOODLANDS AVENUE, ACTON, W.3.

Applications are invited for the post of :

LECTURER IN ELECTRONICS

Candidates should be well qualified and preferably be corporate members of the Institution of Electrical Engineers or the Institute of Physics, and have teaching as well as industrial and/or research experience. There are sandwich courses leading to Dip.Tech. and B.Sc. (Eng.). Opportunities given to take part in the development of research projects.

Salary in accordance with the Burnham (Technical) Report 1956, i.e. £1,200 × £30–£1,350, plus London allowance.

Application forms and further particulars (stamped addressed foolscap envelope) from the Principal to whom completed forms should be returned within 14 days of the appearance of this advertisement.

C. E. Gurr, M.Sc., Ph.D.,
Clerk to the Governing Body.

THE UNIVERSITY OF MANCHESTER

There is a vacancy in the Department of Physics for an electrical or mechanical Engineer to form part of a research team developing a linear accelerator for nuclear physics research. The work will involve design of new apparatus and the supervision of manufacture of large scale equipment. Salary in accordance with qualifications.

Applications should be sent to Professor S. Devons, The University, Oxford Road, Manchester, 13.

## COMMONWEALTH OF AUSTRALIA

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION

DIVISION OF PHYSICS

Appointment No. 770/116 Research Physicist

Applications are invited for appointment to a position of Research Physicist with the Organization's Division of Physics located in the grounds of the University of Sydney.

The Division has an active low temperature research group engaged upon both theoretical and experimental studies of the thermal and electrical properties of solids and of paramagnetic phenomena. Applications are invited from physicists for experimental work in one of these fields. The appointee will be provided with good facilities and assistance and will have an excellent opportunity of participating in a joint attack on solid state problems. Applicants need not necessarily be experienced in low temperature techniques if they can contribute alternative experience in fields typified by paramagnetic resonance or microwave spectroscopy.

Applicants should possess a University honours degree in physics or equivalent qualifications, and should preferably have had research experience up to Ph.D. standard in one or more of the fields typified by paramagnetic resonance, microwave spectroscopy and low temperature physics.

Dependent upon qualifications and experience, commencing salary will be determined within the salary range of Research Officer £A1,313–£A1,938 per annum.

In the case of an appointee domiciled overseas, first-class sea fares to Australia will be paid for the appointee, his wife and family.

The appointment will be conditional upon a satisfactory medical examination and the appointee will be required to contribute to, and be eligible to receive benefits from, either the Commonwealth Superannuation Fund or the Commonwealth Provident Account. Applications quoting Appointment No. 770/116 and stating full name, place, date and year of birth, nationality, marital state, present employment, particulars of qualifications and experience, and of war service, if any, and the names and addresses of three professional referees should reach the undersigned, from whom further particulars may be obtained by April 25, 1958.

A. Shavitsky,
Chief Scientific Liaison Officer.

Australian Scientific Liaison Offices,
Africa House, Kingsway,
London, W.C.2.

## THE UNIVERSITY OF SHEFFIELD

Three Postgraduate Research Bursaries are available in the Department of Fuel Technology and Chemical Engineering, two for work on the Physics and Physical Chemistry of combustion in bench type rigs and the third for research on the Physical Chemistry of soot formation in large flames to be carried out primarily at the International Flame Radiation Centre at Ijmuiden. Value in the range £350–£500 per annum plus fees. Applications should be sent to the Registrar as soon as possible.

## ATOMIC ENERGY RESEARCH ESTABLISHMENT

HARWELL

Vacancies exist in the Metallurgy Division

(*a*) in the Basic Irradiation Studies Group for staff in the Scientific Officer, Experimental Officer and Scientific Assistant classes to work as members of small teams studying the effects of irradiation on the properties of materials required for the Nuclear Power Program (1059Y/110).

(*b*) in the Metal Physics Group for staff in the Experimental Officer and Scientific Assistant classes for work on physics of metals (low temperature, thermal and magnetic properties, diffusion, alloys, etc.) (1059Y/110).

for Physicists and Metallurgists to undertake fundamental research on problems connected with materials for use in thermonuclear reactors. This is a new and interesting field in which theoreticians and experimentalists of a high quality are required.

(*c*) in the Scientific Officer class for Solid State Physicists or Physical Metallurgists with an interest in surface phenomena. Postgraduate research experience on solid state problems is desirable (1089Y/110).

(*d*) In the Experimental Officer class for Physicists and Metallurgists who are primarily good experimentalists. Experience of modern solid state physics or physical metallurgy research techniques would be an advantage (1089Y/110).

Minimum qualifications :

Scientific Officer class—1st or 2nd class honours degree.

Experimental Officer class—G.C.E. in five subjects with two scientific or mathematical subjects at "A" level. Degree or L.I.M. desirable.

Scientific Assistant—G.C.E. "O" level or O.N.C.

Salaries in range £320–£2,080 according to age and qualifications.

Send a Postcard to Group Recruitment Officer, A.E.R.E., Harwell, Didcot, Berks., quoting appropriate reference, for application form and details.

## SENIOR LABORATORY TECHNICIAN

A senior laboratory technician is required to assist in the development and engineering for production of radiation detectors for the nuclear engineering industry. Experience in this field would be an advantage but is not essential. A knowledge of light engineerig and general physics laboratory practice including high vacuum techniques is desirable. The position involves the development of new constructional techniques and the initiation of new designs to meet a wide range of detector problems presented by the Company's rapidly expanding program. Pleasant working conditions and an attractive salary are offered to the right man. Applications should be made in writing to The Personnel Department, Plessey Nucleonics Ltd., Weedon Road, Northampton.

A GRADUATE PHYSICIST is required to conduct research into physical problems associated with the use of tungsten in lamps and valves. Previous experience in high vacuum techniques would be an advantage. Applicants are invited to write to the Director of Research, The British Thomson-Houston Co. Ltd., Rugby, stating age, qualifications, experience and quoting reference JSJ.

# *Appointments Vacant*

*The inclusion of particulars of a vacancy must not be taken to imply that the Institute necessarily approves of the terms offered or that might be offered. Candidates should satisfy themselves that these are satisfactory, and they may always refer to the Institute for advice.*

PHYSICIST. Iraq Petroleum Co. Ltd., requires a Physicist for work in its Reservoir Engineering Laboratory in London on the analysis of reservoir performance with the aid of electric analogue computers. Applicants should have a good honours degree and some experience of electronics.
The selected candidate will be required to spend a short initial period in the Middle East to acquaint himself with the background of the work he will be doing in London. Age range 25-30. Salary will be assessed according to age and experience but will not be less than £800 per annum at 25. There is a pension scheme and luncheon club in the building. Write in full to Staff Manager, Iraq Petroleum Co. Ltd., 214 Oxford Street, London, W.1.

SIEMENS EDISON SWAN RESEARCH LABORATORY

TRANSISTOR RESEARCH

A senior post is vacant for a

PHYSICIST OR ENGINEER

of wide experience to take full charge of research in the field of transistor physics in the new Siemens Edison Swan Research Laboratory. The successful candidate will be required to plan research programmes of a short and a long term nature. The Company also operates development laboratories associated with the engineering departments. Housing is available if required. Please write for further details to : Personnel Officer, Siemens Edison Swan Research Laboratory, West Road, Templefields, Harlow, Essex.

A.E.R.E. HARWELL

EXPERIMENTAL PHYSICIST

An Honours Graduate is required to develop a high intensity positive ion source. The post offers opportunity for the experimental application of fundamental knowledge of gas physics and electronics and for the design of equipment in co-operation with engineering staff. Salary scale £645–£1,120 (starting at up to £825).
Send postcard for details and application form to Group Recruitment Officer (1122/110), A.E.R.E., Harwell, Didcot, Berks.

D.S.I.R. BUILDING RESEARCH STATION, Garston, Watford, Herts., requires Scientific Officer (Physicist) for basic research in heat transfer/aerodynamic/convection processes occurring in heating and ventilation of buildings. Qualifications : 1st or 2nd class Honours degree or equivalent. Salary range (men) : £595–£1,050. Forms from M.L.N.S., Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting A.139/8A.

ESSEX EDUCATION COMMITTEE

SOUTH-EAST ESSEX TECHNICAL COLLEGE

AND

SCHOOL OF ART, LONGBRIDGE ROAD, DAGENHAM.

Applications are invited for appointment as Research Assistants to carry out fundamental research in :

(*a*) Problems in Organic Chemistry (two posts),

(*b*) Electronics, High Vacuum Problems or Interferometry (one post).

Candidates should hold a good honours degree.
Salary : £300 per annum plus additional payment for part-time teaching. Further details from the Clerk to the Governors at the College.

THE MANCHESTER COLLEGE OF SCIENCE AND TECHNOLOGY

(FACULTY OF TECHNOLOGY IN THE UNIVERSITY OF MANCHESTER)

Appointment of

ASSISTANT LECTURER IN PAPER TECHNOLOGY

Applications are invited for an Assistant Lectureship in Paper Technology in the Department of Textile Chemistry in the College, with the title and status of Assistant Lecturer in the University of Manchester. Candidates should possess a good Honours degree in physics, chemistry, chemical engineering or paper technology and be prepared to undertake research work : there will be opportunity to study for a higher degree.
Salary on scale : £700 × £50–£850. Superannuation under the F.S.S.U. Family allowances.
Conditions of appointment and form of application may be obtained from the Registrar, The Manchester College of Science and Technology, Manchester, 1. The last date for the receipt of applications is Saturday, May 31, 1958.

MEDICAL RESEARCH COUNCIL want Senior physicist with honours degree in physics and experience in radiotherapy, at their Betatron Research Group, Christie Hospital and Holt Radium Institute, Manchester, 20, to assist with the application of physics to the clinical use of the 4-MeV Linear Accelerator and the 20-MeV Betatron ; there will also be an opportunity to take part in research with these machines. Starting salary, according to age, experience, and qualifications, on scale £1,125 (× £25–£1,250) ; children's allowances at the rate of £50 per annum per child payable in addition. Superannuation provisions under F.S.S.U. or N.H.S.S.S.
Detailed applications, giving the names of two academic referees, should be sent to Dr. Ralston Paterson, Honorary Director of the Group, at the Christie Hospital and Holt Radium Institute.

## BRITISH THOMSON-HOUSTON CO., LTD.

The British Thomson-Houston Co. Ltd., invites applications for posts in its Research Laboratory at Rugby in an expanding research group working on a number of interesting physical problems.

(i) A physicist or physical chemist to carry out experimental work on the relations between gases, ionized gases and solids.

(ii) A mathematician or physicist to carry out mathematical investigations, mainly on problems connected with gas discharges.

Applicants should have good honours degrees, some knowledge of low pressure techniques would be useful but not essential for (i), and some knowledge of digital computer techniques for (ii). The successful applicants will, however, have ample opportunity to acquire and expand their knowledge of these and other techniques. Applicants are invited to write to the Director of Research, The British Thomson-Houston Co. Ltd., Rugby, giving details of age, qualifications, etc., and quoting reference CAM.

## THE MANCHESTER COLLEGE OF SCIENCE AND TECHNOLOGY

(Faculty of Technology in the University of Manchester)

Appointment of

LECTURER IN TEXTILE CHEMISTRY

Applications are invited for a Lectureship in Textile Chemistry in the College with the title and status of Lecturer in the University of Manchester.

Candidates should be Honours graduates in physics or chemistry and will be expected to carry out research on physical, physico-chemical or chemical aspects of textiles for which good facilities are available.

Salary : according to qualifications and experience on scale £900 × £50–£1,350 × £75–£1,650. Superannuation under the F.S.S.U. Children's allowances. Conditions of appointment and form of application may be obtained from The Registrar, The Manchester College of Science and Technology, Manchester, 1. The last date for the receipt of applications is Saturday, May 31, 1958.

MEDICAL RESEARCH COUNCIL have the following scientific vacancies at the Radiological Protection Service (M.R.C. and Ministry of Health), Clifton Avenue, Belmont, Sutton, Surrey.

1. Physicist, to deal with plans and radiation surveys of installations employing ionizing radiations of all types. Opportunities for research into problems of structural protection will be available.
2. Physicist, to investigate miscellaneous radiation protection problems, e.g. X-rays from television sets.

Applicants should hold good honours degrees in physics or equivalents. Salary (according to age and experience) at point in range £780–£1,130. Superannuation provision after one year for newly qualified graduates, immediately for others. Child allowances. Applications (full details of academic and subsequent careers, and names of two professional referees) to Director of Service, from whom further details may be obtained.

## THE MANCHESTER COLLEGE OF SCIENCE AND TECHNOLOGY

(Faculty of Technology in the University of Manchester)

Appointment of

ASSISTANT LECTURER IN PHYSICS

Applications are invited for an Assistant Lectureship in Physics with the title and status of Assistant Lecturer in the University of Manchester.

The successful candidate will be required to take part in the teaching work of the Department, which is almost entirely concerned with internal degrees of the Faculty in Physics and other subjects. He will be allowed ample time for research, the main subjects at present being physical optics and X-ray diffraction.

Salary : On the scale £700 × £50–£850 per annum. Superannuation under the F.S.S.U. Family allowances.

Conditions of appointment and form of application may be obtained from The Registrar, The Manchester College of Science and Technology, Manchester, 1. The last date for the receipt of applications is Saturday, May 31, 1958.

## SUNDERLAND EDUCATION AUTHORITY

Technical College

Applications are invited for the post of Lecturer in the Physics Department to commence duties on September 1, 1958. Candidates must be well qualified and preference will be given to those who have had teaching and industrial experience. The successful candidate will be required to teach some branch of Applied Physics. Opportunity will be available for research. Salary will be in accordance with the Burnham Scale for Lecturers :—£1,200 × £30–£1,350, plus allowances for industrial experience in approved cases. Further particulars and forms of application may be obtained from the Registrar, Technical College, Sunderland, Co. Durham. Applications should reach the undersigned as soon as possible after the appearance of this advertisement. Canvassing will be a disqualification.

W. Thompson,
Director of Education.

Education Offices,
15 John Street,
Sunderland.

## ESSEX EDUCATION COMMITTEE

South-East Essex Technical College
Longbridge Road, Dagenham

Required in September :

Two Assistants Grade B for Physics. Candidates should have an honours degree in physics and an interest in some branch of applied physics. Teaching and industrial experience is desirable.

Salary : £650 × £25–£1,025 (men) and £580 × £20–£820 plus equal pay increments (women). Additions to both scales for degree or equivalent and approved training. Increments within the scales for previous teaching service, approved industrial experience and War/National Service. London allowance (£36 or £48 p.a.) payable.

Details and application forms (stamped addressed foolscap envelope) from the Clerk to the Governors at the College.

## UNIVERSITY OF KHARTOUM

Applications are invited for (*a*) Senior Lectureship or (*b*) Lectureship in Physics. Salary scales (*a*) £S1,602 × £75–£S1,977 p.a., (*b*) £S1,152 × £75–£S1,677 p.a., entry point according to qualifications and experience. Cost of living allowance approximately £S130 p.a. Outfit allowance £S50. Family allowances : wife £S60 p.a., 1st child £S90, 2nd and 3rd child £S30 p.a. each. (£S1 = £1 0s. 6d. sterling.) Passages for appointee and family on appointment, termination and annual leave. Initial appointment five years. Superannuation scheme.
Detailed applications (eight copies) naming three referees as soon as possible to Secretary, Inter-University Council for Higher Education Overseas, 29 Woburn Square, London, W.C.1, from whom further particulars may be obtained.

## THE MANCHESTER COLLEGE OF SCIENCE AND TECHNOLOGY

(FACULTY OF TECHNOLOGY IN THE UNIVERSITY OF MANCHESTER)

Appointment of

LECTURER IN BUILDING SCIENCE

Applications are invited for a Lectureship in the Department of Building in The Manchester College of Science and Technology, with the title and status of Lecturer in the University of Manchester.
Candidates with a degree in physics, an interest in building science and some industrial or research experience would be preferred, but applications will be welcomed from architects or engineers with specialized knowledge. Members of staff are expected to undertake, assist in, or supervise research.
Salary : £900 × £50–£1,350 × £75–£1,650 with a family allowance of £50 per child and F.S.S.U. benefits. Starting salary according to qualifications and experience.
Conditions of appointment and form of application may be obtained from the Registrar, The Manchester College of Science and Technology, Manchester, 1. The last day for the receipt of applications is Saturday, May 31, 1958.

B. V. Bowden,
Principal of the College.

PHYSICIST—assistant required for the investigation of a wide variety of problems using X-ray crystallographic analysis and electron microscopy. Previous experience, although desirable, is not essential but applicants should be of H.N.C. or Inter B.Sc. standard. Five-day week, pension scheme, canteen facilities. Applications giving details of age, qualifications and experience should be made to the Personnel Officer, British Insulated Callender's Cables Ltd., Research Laboratories, 38 Wood Lane, London, W.12.

PHYSICIST with good knowledge modern physics and interest in its literature required as editor for Section A (Physics) of monthly publication *Science Abstracts*. Age about 30 or over. Starting salary up to £1,450 according to age, qualifications and experience. Pension Scheme. Apply Secretary, The Institution of Electrical Engineers, Savoy Place, W.C.2.

## NORTHERN POLYTECHNIC,

HOLLOWAY, LONDON, N.7.

The Governing Body invite immediate applications for appointment as full-time Assistant Lecturer in Physics to commence in September, 1958. Facilities available for research or postgraduate study. Salary scale—men : £650 × £25–£1,025 ; women : £620 by equal pay increments to £1,025 ; together with allowances in accordance with the Burnham Award. Commencing salary according to age, qualifications and experience. Particulars and form of application from the Clerk to the Governors.

PHYSICIST required for infra-red spectrographic research in meteorology. Experience in physical research of Ph.D. order necessary. Salary according to experience. Applications to Professor P. A. Sheppard, Meteorology Department, Imperial College, London, S.W.7.

## MINISTRY OF SUPPLY

INDUSTRIAL CHEMISTS. Twelve pensionable posts for men and women aged 23 and under 35 on 1.1.58 ; extension for regular Forces service, H.M. Overseas Civil Service, established civil service, and temporary service as Industrial Chemist. Candidates must normally have honours degree in metallurgy, engineering, chemistry, physics, or chemical engineering or have achieved Associateship or Graduate Membership of Royal Institute of Chemistry, Associateship of Institution of Metallurgists or Institute of Physics, or corporate membership of Institution of Chemical Engineers. Starting pay (men, London) £665 (23) to £1,085 (34). Maximum £1,250. Five-day week. Promotion prospects. Write Civil Service Commission, 30 Old Burlington Street, London, W.1, for application forms quoting S 4829/58. Closing date, May 22, 1958.

PHYSICIST/PHYSICAL CHEMIST required in Consultants' Laboratoiries. Experience desirable in at least one of the following : electroplating, vacuum techniques, resistors, capacitors, semiconductors, ceramics. Senior starting £1,000–£1,750, Junior £700–£1,000. G. V. Planer Ltd., Windmill Road, Sunbury-on-Thames, Middlesex.

## THE GAS COUNCIL MIDLANDS RESEARCH STATION

PHYCISITS AND CHEMICAL ENGINEERS

Applications are invited from suitably qualified persons for appointments at the above Research Station, which is concerned with new methods of gas manufacture and with improving the use of gas, especially in industry. Candidates should hold an honours degree, or an equivalent qualification, and be free of National Service liabilities. Postgraduate research experience would be an advantage. The commencing salaries will be attractive and related to qualifications and experience.
The Station is in Solihull in Warwickshire and within easy reach of Birmingham. Applications in writing, detailing education, qualifications and experience, should be addressed to the Industrial Relations Officer, West Midlands Gas Board, 6 Augustus Road, Edgbaston, Birmingham, 15, as soon as possible.

J. Swan
Secretary to the Board.

## SENIOR LABORATORY TECHNICIAN

A senior laboratory technician is required to assist in the development and engineering for production of radiation detectors for the nuclear engineering industry. Experience in this field would be an advantage but is not essential. A knowledge of light engineerig and general physics laboratory practice including high vacuum techniques is desirable. The position involves the development of new constructional techniques and the initiation of new designs to meet a wide range of detector problems presented by the Company's rapidly expanding program. Pleasant working conditions and an attractive salary are offered to the right man. Applications should be made in writing to The Personnel Department, Plessey Nucleonics Ltd., Weedon Road, Northampton.

## A.E.R.E. HARWELL

### PHYSICIST

(Neutron Diffraction)

An honours Graduate is required for novel and stimulating work on Neutron Diffraction involving research with neutrons in an unexplored field. There are opportunities for publication.

Breadth of scientific outlook and enthusiasm are more important than experience in the field of diffraction. Salary : £645–£1,425 according to age and experience.

Send postcard for details and application form to Group Recruitment Officer (1106/110), Atomic Energy Research Establishment, Didcot, Berks.

## COMMONWEALTH OF AUSTRALIA

UNIVERSITY OF ADELAIDE

The Elder Chair of Pure and Applied Mathematics falls vacant at the end of this year on the retirement of the present professor, and the University invites applications for SEPARATE CHAIRS in :

### PURE MATHEMATICS
and in
### APPLIED MATHEMATICS

from January 1, 1959.

At this stage it is not proposed to establish separate departments but to retain a single Department of Mathematics. The allocation of administrative duties between the two professors will be determined by the Council after consultation with the professors. Formal terms of appointment and a statement for the information of candidates may be had from the Registrar or from the Secretary, Association of Universities of the British Commonwealth, 36 Gordon Square, London, W.C.1. These documents give general information about tenure, study leave, invalidity, travelling and removal expenses, research, and the current teaching duties of the Department. The University Caldendar may be consulted in the Library of any University which is a member of the A.U.B.C. and candidates in the United Kingdom may borrow from the A.U.B.C. a copy of a coloured film showing the University and the city and surroundings of Adelaide.

The salary attached to each Chair will be £A3,500 a year, with superannuation on the F.S.S.U. basis. Applications, giving the particulars indicated in the statement, should reach the Registrar, University of Adelaide, Adelaide, South Australia, by May 31, 1958.

## THE UNIVERSITY OF SHEFFIELD

Three Postgraduate Research Bursaries are available in the Department of Fuel Technology and Chemical Engineering, two for work on the Physics and Physical Chemistry of combustion in bench type rigs and the third for research on the Physical Chemistry of soot formation in large flames to be carried out primarily at the International Flame Radiation Centre at Ijmuiden. Value in the range £350–£500 per annum plus fees. Applications should be sent to the Registrar as soon as possible.

## BRADFORD INSTITUTE OF TECHNOLOGY

(COLLEGE OF ADVANCED TECHNOLOGY)

Principal : E. G. Edwards, Ph.D., B.Sc., F.R.I.C.

Applications are invited for the post of Senior Lecturer in Physics in the Institute. The Senior Lectureship is one of a number of additional posts established as a result of the extension of the work of the Department. Candidates for the post should be well qualified physicists, and some experience of the application of Physics in Industry would be a recommendation. The capacity to guide research work is a desirable qualification and suitably qualified candidates will be given the time and facilities to undertake research. The salary scale for men, in accordance with the Burnham Technical Award, is from £1,350 to £1,550 per annum.

Previous industrial or research experience at a suitable level may be taken into account in fixing the commencing salary. Further particulars of the appointment and forms of application may be obtained from the Principal, Institute of Technology, Bradford, 7.

W. H. Leathem,
Clerk to the Governors.

BRITISH PETROLEUM CO. LTD. requires GEOPHYSICISTS for world wide service. Candidates must be graduates in physics, geology or mathematics. Commencing basic salary is commensurate with age and experience, with a minimum of £1,130 for young, inexperienced graduates. Appropriate allowances are paid on foreign service. Generous Pension Scheme. Written applications, quoting reference F.533a, should be addressed to The Manager, Recruitment Branch, The British Petroleum Co. Ltd., Britannic House, Finsbury Circus, London, E.C.2.

## VICTORIA UNIVERSITY OF WELLINGTON

NEW ZEALAND

The Council of the Victoria University of Wellington proposes shortly to appoint a Senior Lecturer in the Department of Physics and invites applications from suitably qualified persons for this post. The duties of the successful applicant will lie primarily in the field of theoretical physics.

The salary will be £1,315 per annum, rising by annual increments of £50 to £1,615. The initial salary will be determined according to the qualifications and experience of the appointee. An allowance is made towards travelling expenses.

Further particulars and information as to the method of application may be obtained from the Secretary, Association of Universities of the British Commonwealth, 36 Gordon Square, London, W.C.1.

The closing date for the receipt of applications, in New Zealand and London is July 1, 1958.